



SEQUENCE OF OPERATION FOR ELEVATOR CONTROLLER

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1. SEQUENCE OF OPERATION, BASIC FEATURES

This sequence of operation is as accurate as possible, but the control circuits being described are subject to change, and may be modified for particular job requirements. Refer also to the schematic for details on inputs and outputs, and additional external circuitry.

NOTE: When sequences are described for one floor all other floors are similar. Refer to the schematic for details on specific Inputs and Outputs, and the exact controller wiring.

1.1 FLOOR POSITION

The position of the Elevator is monitored by the internal floor relays in the PLC, which are piloted by the Car Top Selector or by Floor Switches in the hoistway. The floor relays are self-holding, so the floor position will be maintained as the car leaves for another landing, and will be maintained through a power loss. Once the position of the car has been set during initial installation (by energizing a floor switch, or putting the car at a terminal landing, or a Reset Landing) the floor position should not need to be reset again.

Floor Position is indicated by the Position Indicator Outputs, which are piloted by the internal floor relays. Only one Position Indicator Output should be energized at any one time. If no Position Indicators, or more than one Position Indicator is energized at any time, refer to Section 2 for troubleshooting suggestions to determine the cause of the problem. Check the Position Indicator status at the Output Module. If this does not agree with the Position Indicator Lights, then the problem is probably in the field wiring connections. If the Output Module also displays an improper condition, then run the car to a terminal landing or past a Floor Switch, to reset the floor position. If this does not solve the problem consult the factory for further suggestions on checking the CPU Module or the Rack.

During the scan that the new floor relay is energized, the PLC checks to see if there are any calls at the new landing which could initiate slowdown. This means the floor change point determines the slowdown distance. This distance is calculated based on car speed and the desired slowdown rate, and will vary with the responsiveness of the drive system. Standard distances are shown in the table below.

CAR SPEED IN FPM	RECOMMENDED SLOWDOWN	MINIMUM SLOWDOWN
UNDER 200	1' per 50FPM	1' per 50FPM
200	4'-6"	4'-0"
250	5'-6"	5'-0"
300	7'-0"	6'-6"
350	8'-6"	7'-6"
400	10'-0"	9'-0"
450	11'-6"	10'-6"
500	13'-0"	12'-0"
600	16'-0"	15'-0"

NOTE: If multi-floor run circuitry is used, then the One Floor Run Slowdown distance is approximately half the shortest floor height, and the Two Floor Run distance is approximately equal to the shortest floor height.

FLOOR CHANGE - with FLOOR SWITCHES

1. The previous Position Indicator is on as the car starts to run.
2. When the car reaches the Slowdown Point before the next landing, the Floor Switch for the next landing closes.
3. The Floor Switch energizes appropriate Floor Switch Input.
4. The Floor Switch Input changes the internal floor relays. A slowdown would be initiated now, if the appropriate call had been registered.
5. The PLC de-energizes the Position Indicator Output for the previous landing and energizes the Position Indicator Output for the new landing.
6. The Floor Change sequence is complete.

NOTE 1: One Floor Switch Input is required for each landing. The Landing Switches should be set to close at the Slowdown Distance before the floor. It is recommended, though not essential, that the Floor Switch be maintained while the car is in the Slowdown Zone. The Terminal Landing Floor Switches must be closed when the car is floor level at the Terminal Landings. Approximate Slowdown Distances can be estimated based on 6" of Slowdown for each 25fpm of car speed, for speeds up to 200fpm. Adjacent Floor Switches should not be energized at the same time. If any two floors are closer together than twice the required slowdown distance then special Short Floor programming is required to handle this condition.

FLOOR CHANGE - with PULSING SELECTOR

Two sets of Floor Relays are used with pulsing selectors. One set monitors the actual position of the car, called the Synchronous Floor Relays, and the other set monitors the floor that the car can stop at, called the Advancing Floor Relays.

The Synchronous Floor Relays are pulsed up and down by the Up Slowdown Selector targets and the direction relays. That is, if the car runs up past an Up Slowdown Target, the Synchronous Floor Relays will be pulsed up one floor, and if the car runs down past an Up Slowdown Target, the Synchronous Floor Relays will be pulsed down one floor. The only exception to this is at the top terminal landing, where the Up (Slow Speed) Slowdown target has been stretched to provide an actual position reset. In this case, the first pulse down is provided by the Down Slowdown target (on systems that reach full speed on a One Floor Run) or the Up High Speed target (on systems that reach full speed on a Two Floor Run) or the Up Medium Speed target (on systems that reach full speed on a Three Floor Run). If the system uses multi-floor run circuitry, where the car does not reach full speed on a One Floor Run, then the Up Slow Speed Selector targets are used to pulse the Synchronous Floor Relays, and the Up High or Medium Speed targets are used to reset a lockout circuit that prevents contact bounces from giving false floor changes. The operation of the Synchronous Floor Relays can be verified by running the car on Inspection, as the Position Indicators will be piloted directly by the Synchronous Floor Relays. The Position Indicators should change as the car passes the Up (Slow Speed) Slowdown target. Whenever the car stops, the Synchronous Floor Relays will reset the Advancing Floor Relays. So if the floor relays change when the car stops, then the Synchronous Floor Relays must have been different from the Advancing Floor Relays. This could be caused by a missing target, or faulty selector contact. The operation of the Synchronous Floor relays is omitted from the descriptions at the end of this section for clarity, since they will always operate in the same manner, as described above.

The Advancing Floor Relays are used to monitor which floor the car can stop at. When the Advancing Floor Relays change, the slowdown sequence is initiated if the appropriate call is registered. The Advancing Floor Relays are pulsed by the High Speed Slowdown targets for the direction that the car is travelling in. If multi-floor run circuitry is used, then the advancing floor relays will automatically advance as the car starts to run. If the car can reach full speed on a two floor run, then the Advancing Floor Relays will advance once, but if the car can reach full speed on a three floor run, then the Advancing Floor Relays will advance twice.

NOTE: The Synchronous and Advancing Floor Relays are reset at either terminal landing. If the Up Slow Speed Slowdown Switch and the Low Level/Door Zone Switch are energized at the same time, this will reset the floor relays to the Top Landing. If the Down Slow Speed Slowdown Switch and the Low Level/Door Zone Switch are energized at the same time, this will reset the floor relays to the Bottom

Landing. If a Main Landing Reset Switch is used, this will reset the Synchronous Floor Relays to the Main Landing whenever it is energized. It is recommended that a Main Landing Reset Switch be used when the bottom landing is seldom used.

NOTE: The Position Indicators are driven by the Advancing Floor Relays if the car can reach full speed on a two floor run or less (if the car speed is less than 350fpm), otherwise they are driven by the Synchronous Floor Relays.

FLOOR CHANGE SEQUENCE for ADVANCING FLOOR RELAYS

Example 1: with no Multi-Floor Run circuitry.

1. The car starts to run down.
2. The car passes an Down Slowdown Target. The Advancing Floor Relays pulse down one floor. The Position Indicator changes. The slowdown sequence is initiated now, if the appropriate call exists.
3. Repeat step 2 for each floor until the car stops.

NOTE 3: Slowdown distance is less than half the shortest floor height.

Example 2: with Full Speed on a Two Floor Run.

1. The car starts to run down.
2. After the car has been running for approximately one second, the Advancing Floor Relays automatically advance, to determine whether the car will go on a short (1 floor) or long (multi-floor) run. An Advancing Floor Change lock-out is set, to prevent another floor change until the car passes a Down Slow Speed target. The Position Indicator changes.
3. The car passes a Down High Speed Slowdown target. The first time the car passes a Down High Speed Slowdown target, it is cut out by the floor change lock out as described in step 2. The second time the car passes a Down High Speed Slowdown target, after the car has gone one complete floor, this will pulse the Advancing Floor relays to the next floor in the direction of travel, change the Position Indicator, and initiate the slowdown for a multi-floor run if the appropriate call exists. The Advancing Floor Change lockout is also set, to prevent another floor change until the car has passed a Down Slow Speed Slowdown target.
4. The car passes a Down Slow Speed Slowdown target. This will initiate a slowdown if the car is doing a one floor run. It also resets the Advancing Floor Change lockout.
5. Repeat steps 3 and 4 for each floor until the car stops.

NOTE 4: The One Floor Run slowdown distance is less than half the shortest floor height. The Full Speed Run slowdown distance is less than half the shortest distance between two adjacent floors.

NOTE 5: On Inspection operation, the initial false advancing pulse is not used, and the Advancing and Synchronous floor relays pulse from the Up Slow and Up High Speed Selector targets.

Example 3: with Full Speed on a Three Floor Run.

1. The car starts to run down.
2. After the car has been running for approximately one second, the Advancing Floor Relays automatically advance, to determine whether the car will go on a one floor run. This will initiate the slowdown sequence if the appropriate call exists.
3. After the car has been running for approximately two seconds, and if a slowdown was not initiated in step 2, then the Advancing Floor Relays automatically advance a second time, to determine whether the car will go on a two floor run. This will initiate the slowdown sequence if the appropriate call exists.
4. The car passes a Down Slow Speed Slowdown target (which would start the actual slowdown sequence for a one floor run), then a Down Medium Speed target (which would start the actual slowdown sequence for a two floor run). The Advancing Floor Change lockout is now reset.
5. The car passes a Down High Speed Slowdown target which pulses the Advancing Floor Relays, and will

initiate the slowdown sequence if the appropriate call exists. The Advancing Floor Change lockout is set.

6. The car passes a Down Medium Speed Slowdown target. This resets the Advancing Floor Change lockout. The Down Slow Speed Target has no effect on the Advancing Floor Relays.
7. Repeat steps 5 and 6 for each floor until the car stops.

NOTE 6: The One Floor Run slowdown distance is less than half the shortest floor height. The Two Floor Run slowdown distance is less than half the shortest distance between two adjacent floors.

NOTE 7: On Inspection operation, the initial false advancing pulses are not used, and the Advancing and Synchronous floor relays pulse from the Up Slow and Up Medium Speed Selector targets.

The Floor Relays are reset at either terminal landing. If the Up Slowdown Switch and the Low Level/Door Zone Switch are energized at the same time, this will reset the floor relays to the Top Landing. If the Down Slowdown Switch and the Low Level/Door Zone Switch are energized at the same time, this will reset the floor relays to the Bottom Landing. If a Main Landing Reset Switch is used, this will reset the Floor Relays to the Main Landing whenever it is energized. It is recommended that a Main Landing Reset Switch be used when the bottom landing is seldom used.

1.2 CAR CALLS

Momentary closure of a Car Call Button will energize the corresponding Car Call Button Input. The PLC then turns on the corresponding Car Call Light, and holds the call until the car has answered the call, and it is cancelled as shown below.

Individual Car Calls are cancelled when the car slows down for the call at the appropriate floor, or reopens its doors at the same floor as the Car Call.

All Car Calls are cancelled when the car is on Inspection Operation, Independent Service or Fire Service as described later.

Example 1:

1. The car is not at 1 and 1C Car Call is registered.
2. 1C Car Call Button is pressed, energizing the 1C Car Call Input.
3. The PLC holds the call and turns on the 1C Car Call Light.
4. The PLC initiates the run to the 1st landing to answer the call.
5. The car slows down at the 1st landing in response to the 1C call.
6. The PLC cancels the call when slowdown is initiated.
7. The 1C Car Call Light goes out.
8. The doors will open in response to the call when the car stops.

Example 2:

1. The car is at the 1st landing and 1C is energized.
2. 1C Car Call Button is pressed, energizing the 1C Car Call Input.
3. The PLC holds the call and turns on the 1C Car Call Light.
4. The PLC initiates the Door Open cycle, and cancels the call.
5. The 1C Car Call Light goes out.

1.3 HALL CALLS

Momentary closure of a Hall Call Button will energize the corresponding Hall Call Button Input. The PLC then turns on the corresponding Hall Call Light, and holds the call until the car has answered the call, and it is cancelled as shown below. Note that the car must be going in the appropriate direction to be able to cancel the

call.

Individual Hall Calls are cancelled when the car slows down for the call at the appropriate floor, or reopens its doors at the same floor as the Hall Call, provided the car is going in the same direction as the call.

All calls are cancelled when the car is on Fire Service, or on Shutdown. Simplex systems will also cancel all Hall Calls on Inspection Operation.

Example 1:

1. The car is not at 1 and 1U Hall Call is registered.
2. 1U Hall Call Button is pressed, energizing the 1U Hall Call Input
3. The PLC holds the call and turns on the 1U Hall Call Light
4. The PLC initiates the run to the 1st landing to answer the call
5. The car slows down at the 1st landing in response to the 1U call
6. The PLC cancels the call when slowdown is initiated.
7. The 1U Hall Call Light goes out.
8. The doors will open in response to the call when the car stops.

Example 2:

1. The car is at the 1st landing and 1U is energized.
2. 1U Hall Call Button is pressed, energizing the 1U Hall Call Input
3. The PLC holds the call and turns on the 1U Hall Call Light
4. The PLC initiates the Door Open cycle, and cancels the call.
5. The 1U Hall Call Light goes out.

NOTE 1: On Duplex systems, the Hall Call Buttons are connected to the Input Modules of BOTH cars, so that both cars will register each call. They will both turn on their Hall Call Light outputs. One car, as designated by the internal programming, and communication between the cars, will answer the call. Either car may cancel any call, and this will initiate a cancel signal in the communication between the cars, so that they both cancel the call. This system allows for normal operation should one car be unable to operate properly.

1.4 DIRECTION SELECTION

Direction Selection is determined by the PLC, which compares the location of the calls with the location of the car to determine the correct direction of travel to answer each registered call. The selected direction is indicated by the Direction Indicator Outputs. On Automatic Operation, a call should register a direction. Refer to the troubleshooting section if this does not happen. On Inspection Operation, the direction is selected by the Up and Down Inspection buttons. Once a direction is selected, it will lock out the opposite direction, thus allowing only one direction to be selected at any particular time.

NOTE 1: Direction preference for the Hall Call that the car has stopped for is provided by the PLC. If the car has stopped for an Up Hall call, the PLC will delay the selection of the Down Direction, thus allowing time for the passenger to enter the car and register a call in the down direction. Similarly with the Down Direction. The PLC will prevent a direction reversal for approximately 4 seconds after the door time expires and the doors start to close. If the car stops for a call in the opposite direction to the direction that the car is running (that is the car stops for a down call when it going up, or vice versa), then the PLC will reverse the direction selection to correspond to the demand.

Example:

1. The car is at the 2nd landing.

2. A 2C Car Call would re-open the doors and not select a direction.
3. A 2U Hall Call would open the doors and energize the Up Direction.
4. A 2D Hall Call would open the doors and energize the Down Direction.
5. A call above the car would energize the Up Direction Indicator.
6. A call below the car would energize the Down Direction Indicator.

1.5 DIRECTION HOLD

The PLC will hold the direction selected once it has started its full speed run until the car has stopped. This allows the Direction Indicators to change or de-energize while the car is running, especially at slowdown, without affecting the movement of the car.

NOTE 1: If further demand exists in the current direction of travel, the Direction Indicators will remain energized, thus holding the direction until all demand in that direction had been answered.

NOTE 2: If the car is operating on Inspection Operation, the direction of the car may be reversed as soon as the car has stopped.

1.6 DIRECTION RUN

When a demand has been initiated, and the doors have closed, the car will run in response to the demand. The car starts in Fast Speed, and slows down when it reaches a floor where an appropriate call exists. The car stops when it rides onto then off a leveling switch. The car will then be between the Up Level and the Down Level switches. The doors will open automatically, remain open for a preset time, and then close automatically. The car will then be ready to run to the next call. The operation of the above features is described in the next few sections.

A general description of the sequence is given below. For details on the sequence for a specific type of controller, see Section 2.

STARTING (Refer to the safety circuits on the schematic)

Example: UP RUN (Down direction is similar).

1. A call above the car is registered. The call energizes the Up Direction Indicator. The MG Set or Drive will start, if it is not already running. After the Door Time expires, the doors will start to close.
2. The doors close, and all other Safety Devices are assumed to be closed.
3. DC relay energizes when the doors close. DC relay energizes the Doors Closed Input to the PLC
4. The PLC turns on the Up Run Output, and all Speed Selection Outputs (Fast Speed Output, One Floor Run Output, Two Floor Run Output, etc.) and the Leveling Cutout Output, if used.
5. The running relays and contactors energize.
6. With MG set systems, the Generator suicide circuit opens, and power is applied to the Generator Shunt Field. With SCR Drive systems, the drive enable circuit is closed, and the drive starts to control car movement.
7. The Speed Selection relays select the speed for the drive system.
8. BK1 and BK2 lift the Brake.
9. The Leveling Switches are cut out.

ACCELERATION See also to Section 2.

1. The Speed Selection Relays (FS, 1FR, 2FR, etc) will select the speed that the system will ramp to.
2. With M.G. sets, the output to the Generator Shunt Field will gradually rise. As the Generator Shunt Field voltage rises, the Generator Armature output voltage also rises, causing the hoistmotor to accelerate.

3. With SCR Drives, the S-curve Generator output will ramp up, causing the drive to increase the Hoistmotor Armature output, and the car to accelerate at the rate set by the acceleration pot on the S-curve generator.
4. The speeds that the car will reach on a One Floor or Multi-floor Run are determined by the settings on the drive system speed pots.

NOTE 1: With M.G. sets, adjust the High Speed setting to produce maximum rated voltage on the Generator Shunt Field, then adjust the Hoistmotor Field weakening to achieve contract speed.

NOTE 2: Adjust the One Floor Run speed to achieve the optimum run on the shortest one floor run. Adjust the Two Floor Run speed to achieve the optimum run on the shortest two floor run.

NOTE 3: If the car has multi-floor run circuitry, and is going on a run that will not reach full speed, then the Fast Speed relay will drop out before the car reaches one (or two) floor run speed. This allows the car to ramp to the correct speed, without a bump in the acceleration pattern.

DECELERATION See also Section 1.7

1. Slowdown is initiated at the appropriate floor change/slowdown point.
2. The PLC de-energizes the Speed Selection Outputs and decelerates to approach speed.

NOTE 4: If the car has multi-floor run circuitry, and is going on a run that will not reach full speed, then the Fast Speed relay will drop out when the Advancing Floor Relays step out at the start of the run, before the car reaches one (or two) floor run speed. The One (or Two) Floor Run Speed relay remains energized to allow the car to accelerate to One (or Two) Floor Run Speed.

STOPPING

Example:

1. The car has slowed down to stop at the next landing, and it is traveling in the up direction. The fast speed relays have de-energized and the car is decelerating to Approach Speed. The leveling units are activated.
2. The car reaches the Leveling Target and energizes the Up Level Switch.
3. The Up Level Switch energizes UL relay and the PLC Up Level Input. The car ramps to Leveling Speed.
4. The car rides onto the Low Level/Door Zone Switch and energizes the Low Level/Door Zone Input.
5. The PLC de-energizes the Door Close output, removing torque from the doors. The doors are now set up to open when the car stops.
6. The Door Contacts are by-passed by UL relay.

NOTE 4: Sufficient slowdown distance should be allowed for the car to reach Leveling Speed before it rides off the Leveling Target and attempts to stop. This allows for a more controlled stop.

7. The car rides off the Up Level Switch which de-energizes the UL relay and the Up Level Input.
8. The PLC de-energizes the Up Run Output, which de-energizes up run relays.
9. In M.G. set systems, a reverse charge is applied across the Generator Shunt Field, to provide an electric stop. This allows for a soft stop, while the brake is setting. In SCR Drive systems, the drive will hold the car at zero speed until the brake sets.
10. The brake sets.
11. After a brief time delay (approximately 1 second) UDT and UDTX will de-energize. On M.G. set systems this closes the suicide circuit. On SCR Drive systems, it turns off the drive run circuit, and opens the drive contactor.

NOTE 5: On M.G. set systems, the suicide circuit connects the Generator Shunt Field across the Generator Armature in such a way as to apply the residual Generator Armature voltage across the Generator Shunt Field so that it is cancelled, or suicided. This is a very important circuit since it involves

the fail-safe operation of the elevator. The circuit should be checked periodically for proper operation. The contacts in the suicide circuit should be checked regularly for pitting or wear.

NOTE 6: A Shutdown Timer in the PLC will shut the car down if it runs for more than 30-60 seconds without passing a floor change point (Synchronous or Advancing). The car doors will operate, but the car will not move until the timer is reset by cycling the power, or cycling the Inspection Switch.

NOTE 7: A Leveling Cutout Timer in the PLC cuts out leveling after 15 seconds. The car will then stop, open the doors if it is in the Door Zone, then continue to run in response to other calls.

1.7 SLOWDOWN

Slowdown is initiated when the Car changes floors and a call is registered at the landing the car has now reached. This occurs when the car reaches the Floor Change or Slowdown Point, as described in Section 1.1 of this Sequence of Operation. At Slowdown, the deceleration sequence is initiated, as described in Section 1.6.

Example:

1. The floor relays change at the appropriate floor change point. (see Section 1.1, Floor Change).
2. During the Floor Change, the PLC compares the new car position with the registered calls.
3. Slowdown will be initiated by a Car Call at the new landing, or a Hall Call at the new landing that is in the direction of travel, or that is in the opposite direction if there are no further calls ahead of the car.
4. The PLC de-energizes the fast speed relays(s), and initiates deceleration as described in the previous section.

NOTE 1: If the car slows down for an Up Hall Call, the PLC will energize the Up Direction Indicator, to give preference to the Up direction. If the car slows down for a Down Hall Call, the PLC will energize the Down Direction Indicator, to give preference to the Down direction. Direction preference will be held until the doors have started to close. If a call has not yet been registered in the preferred direction, the direction may now be reversed.

1.8 RE-LEVELING

Stopping is initiated by the Leveling Switches, as described in Section 1.6. The car rides onto then off one of the Leveling Switches, and this will initiate the stopping sequence. The Leveling Switches also provide a means to re-level the car, and keep it within a preset distance from the floor. A relevel is initiated when the car was floor level, but a change in load, or other conditions caused it to move onto one of the Leveling Switches. The car will then move back to floor level. Leveling can be done with the doors open, but not with the Emergency Stop Switch in the "Off" position.

The Leveling Zone is the distance above and below the floor that the Leveling Switches are energized. The Leveling Dead Zone is the distance above and below floor level that the car can move without energizing a leveling switch, and being moved back to the floor.

Example:

1. The car sinks down onto the Up Level Switch.
2. The Up Level Switch energizes UL relay and the Up Level Input.
3. The PLC prevents the fast speed outputs from energizing.
4. The PLC energizes the Up Run Output. This initiates a run as described in section 1.6, except the speed is set to relevel speed, since UL is energized and no fast speed relays are energized.
5. The car runs up at leveling speed.
6. When the car rides off the Up Leveling Switch it follows the sequence described above for stopping.

NOTE 1: The car can re-level with the doors open, since the UL relay will bypass the Door Contacts. The combination of contacts in parallel with the Door Contacts prevents the Door Contacts from being

bypassed in the event that one of the relays fails.

NOTE 2: A Leveling Cutout Timer in the PLC cuts out leveling after 15 seconds. The car will then stop, open the doors if it is in the Door Zone, then continue to run in response to other calls.

1.9 DOOR OPEN AND CLOSE

The Door Operator Motor is a DC Fractional Horsepower Motor, with a separately excited Shunt Field. The direction of rotation of the motor is determined by the condition of O and C, the Door Open and Close relays. The Door Open and Close relays are piloted by the PLC, and are mounted in the MODSS Pilot Operator on top of the car. If an MODSS Pilot Operator is not used, the operation is still similar for all passenger doors.

The Door Open and Door Close are subject to the following devices:

1. The Governor, Up and Down Final Limit Sws, Pit Sw and Inspection Stop Sw (and any other devices connected between terminals 1 and 3) cut out Door Open and Close.
2. The Emergency Stop Switch cuts out Door Close.
3. Inspection Access cuts out Door Open and Door Close through the PLC
4. The Low Level/Door Zone Switch must be closed to allow Door Open.
5. Fire Service affects Door Open and Close per code requirements.
6. Open and Close Timers in the PLC prevent door operation for more than 15 seconds.
7. Open and Close Timers in the PLC prevent an immediate reversal of open to close or close to open.

AUTOMATIC DOOR OPEN WHEN THE CAR STOPS

Leveling initiates an internal door open sequence in the PLC. The Door Close relay is de-energized, removing torque from the doors, so the doors are set up to open when the car stops.

1. When the car stops, the PLC energizes the Door Open Output.
2. This applies power to the Door Operator Motor and the doors open.
3. When the doors get fully open, the Door Open Limit de-energizes the Door Open Output, through the PLC, and stops the Door Motor.
4. The PLC now holds the doors open for the Door Time. This door time may be adjusted as described in Section 3. The factory setting is 5 seconds after the doors have reached the fully open position.

DOOR CLOSE

1. The PLC will initiate the Door Close sequence, after the expiration of the Door Time, by energizing the Door Close Output.
2. This applies power to the Door Operator Motor and the doors close.
3. When the doors are fully closed, the Door Close Limit de-energizes the Door Close Output, through the PLC, and power is removed from the Door Operator Motor.

NOTE 1: With GAL type doors, the PLC by-passes the Door Close Limit Switch when a direction is selected or the car is running. This maintains torque on the door while the car is running.

NOTE 2: The most common cause for door operation problems is the Door Close Limit Switch. Some symptoms include excessive door open time, incorrect operation on Fire Service or Independent Service, door recycling. Always check the Door Close Limit operation carefully.

NOTE 3: On group systems, if the doors are cut out, such as during start-up, the car will initiate an internal fault, putting the car out of group service, which will prevent the car from cancelling calls, and may interfere with other dispatching functions.

SHORTENED DOOR TIME

1. The normal Door Time, that is the time that the doors remain open after getting fully open, and before

beginning to close, is 5 seconds. This time is adjustable, as described in section 3.

2. The Door Time is shortened to 2 seconds if:
3. The car is stopping for a Car Call only, or
4. The car is stopping for a Hall Call, and a Car Call Button or Door Close Button has been pressed since the car stopped at the landing.
5. The Door Time is shortened to 1 second if:
6. The car is stopping for a Car Call only, and the Electric Eye, Safety Edge, or Door Open Button has been energized, or
7. The doors were closing and the Electric Eye, Safety Edge, or Door Open Button has been energized, causing a door re-open, or
8. The Door Nudging or Load Weighing feature has been activated (if used).
9. The Door Time is shortened to 0.3 seconds if the car is on some special operation, such as Fire Service, Independent Service, Attendant Operation.

DOOR REOPEN

The doors can be re-opened by registering a call at the same landing as the car, or by pressing the Door Open Button, the Safety Edge, or the Electric Eye. The PLC will de-energize the Door Close Output and energize the Door Open Output, thus opening the doors. The Door Time will be shortened as described above.

Door Reopen sequence:

1. The Car or Hall Call Button is pressed.
2. The corresponding Input will come on.
3. The PLC registers the call, and lights the light, and at the same time initiates the door open sequence. The Call Register Light may flash very quickly, but should go out as soon as the doors start to open.
4. The M.G. set or Drive will start up, if it was not already on.

NOTE 4: The sequence is similar for a reopening from the Electric Eye, Safety Edge or Door Open Button. The Door Time will start timing from the release of the reopening device.

POWER FREIGHT DOOR OPERATION

The Power Freight Doors are controlled by a separate Door Controller provided by others. The following Initiatory Contacts are provided to pilot the Door Controller.

"AUTOMATIC OPEN" - Provides a signal to automatically open the doors. It is energized when the car stops for a call, or when a call is registered for the floor that the car is at.

"RETIRING CAM" - Provides a signal to lift the Retiring Cam. Energized when the doors are closed, and a call is registered. The Retiring Cam will lift, and lock the doors, allowing the car to run. If the car is on Fire Service Phase 1, the Retiring Cam will not drop when the car does a reversal to return to the Main Landing. This prevents the Door Open Buttons from opening the doors while the car is reversing direction.

"CUT OUT" - Cuts out normal door operation when the car is on Inspection Operation, or when the Stop Switch is thrown.

"HOME LANDING" - Energized when the car is at the Fire Return Ldg, if used.

"FIRE SERVICE PHASE 1" - Energized on Fire Service Phase 1, Hall, if used.

"FIRE SERVICE PHASE 2" - Energized on Fire Service Phase 2, Car, if used.

"FIRE SERVICE PHASE 2, OFF" - Energized when Car Fire Sw is in the "Off" position, if used.

"ATTENDANT SERVICE" - Energized on Attendant Service, if used.

NOTE: The doors will open automatically when the car first arrives at a floor, or when a call is placed at

the floor that the car is at. The Door Open signal will be cut out after approximately 10 seconds if the doors fail to open. The doors also may be opened by means of the "Door Open" buttons connected to the Door Controller. Door Close is initiated by the "Door Close" buttons connected to the Door Controller. There are normally no provisions for controlling the door close sequence from the Virginia Controls controller.

When the doors are closed, the car will wait for a call to be registered. A call will cause the Retiring Cam to lift, the doors to be locked, and the car will then run to the call.

When the Retiring Cam starts to lift, an internal timer starts timing. If the timer trips before the car starts to run, it will cancel the Retiring Cam Output, re-establish the door time, then re-try to lift the cam. This prevents damage to the Retiring Cam Motor if it tries to close for an extended period of time when it is blocked for some reason.

1.10 INSPECTION OPERATION

Inspection Operation provides a means to move the car from on top of the car. The car is moved by constant pressure of an Up or Down Button and a Run Button in the top of car station. The car runs at a reduced speed of less than 150 feet per minute.

Hoistway Access Switches provide a means to move the car from the hall station in a similar manner to Inspection, to allow an operator to get on top of the car. When the Hoistway Access Switch in the Hall is closed, one pole by-passes the Car Door Contact and appropriate Door Contact. The second pole is connected in parallel with the Inspection Buttons.

HOISTWAY ACCESS SWITCHES

1. The Inspection Access Key Switch in the car energizes the "IAS" relay, and the common to the Access Switches, and cuts out the Car Call Buttons, Leveling Switches, and the Inspection Input to the PLC
2. The PLC prevents the doors from opening, and cuts out normal Automatic Operation. Door Close is cut out by the external "IAS" contact.
3. The Hoistway Access Switch is turned to move the car up or down from the terminal landing.
4. The 1st pole bypasses the Car Door and Bottom or Top Door Contact.
5. The 2nd pole energizes the 1st or 2nd Landing Car Call Button Input to the PLC (provided the Zone Switch is energized).
6. The PLC energizes the appropriate outputs to run the car as described in section 1.6, EXCEPT fast speed relays do NOT energize, so the car will run at reduced speed on Hoistway Access, and Inspection Operation.
7. When the switch is released, the PLC de-energizes the run outputs, causing the car to stop immediately.

TOP OF CAR INSPECTION

1. The Top of Car Inspection Switch is thrown to "Inspection".
2. The Hoistway Access Switches are cut out.
3. The Top of Car Up, Down and Run Buttons are activated.
4. The Hoistway Access Switches, Leveling Switches, and the Car Call Buttons are cut out.
5. The PLC cuts out the Hall Calls, the Door Open and prevents the automatic operation of the car.
6. Pressing both the Run and Up Inspection Button energizes the 2nd Landing Car Call Button Input.
7. Pressing both the Run and Down Inspection Button energizes the 1st Landing Car Call Button Input.
8. The PLC energizes the appropriate direction run outputs when the Inspection Input is de-energized, the doors are closed, and only one of the 1st or 2nd Car Call Button Inputs is energized.

NOTE 1: When either button is released the PLC will de-energize the run outputs, and the car will stop.

NOTE 2: If both the 1st and 2nd Car Call Button Inputs are energized, the PLC will stop the car. If the

Inspection Input is energized while the car is running on Inspection, the car will stop. The car will only return to Automatic Operation when the Inspection Run Buttons have been released and the Inspection Input is on. This prevents a feedback, button failure, or operator error from running the car, or returning the car to Automatic Operation.

2 SEQUENCE OF OPERATION, SPECIAL FEATURES

NOTE: When sequences are described for one floor all other floors are similar. Refer to the schematic for details on specific Inputs and Outputs, and the exact controller wiring. Refer also to the G.E. Manual for Operating Instructions for the PLC.

2.1 FIRE SERVICE OPERATION

FIRE SERVICE PHASE 1 (HALL)

Fire Service Phase 1 returns the car to the Main or Alternate Landing when a fire is detected. It is initiated by de-energizing the Fire Service Input to the PLC by the activation of a Smoke Sensor, or by turning the Firemen's Switch in the hall to the ON position. The Main Landing Smoke Sensor Input determines whether the car should return to the Main Fire Service Landing (if the Input is energized), or to the Alternate Fire Service Landing (if the Input is de-energized). The Smoke Sensors can be bypassed, returning the car to normal operation, by turning the hall Fire Switch to the Bypass position.

On Fire Service Phase 1, the following changes in operation occur:

1. Car Calls, Hall Calls and Direction Lanterns are cut out.
2. A direction is set up to bring the car to the Fire Return landing.

NOTE 1: With Alternate Landings, the proper landing is determined by the status of the Main Landing Smoke Sensor Input when Fire Service is initiated. If the Main Landing Smoke Sensor Input is energized, the car will return to the Main Landing. If the Input is de-energized, the car will return to the Alternate Landing. Any change in Smoke Sensor contacts will not affect the designated landing once Fire Service is initiated. However, if the Hall Fire Switch is turned to the On position, the car will return to the Main Landing, even if the Main Landing Smoke Sensor had tripped and sent the car to the Alternate Landing.

3. The doors will not open automatically except at the Main Landing.
4. If the doors are already open at a landing other than the designated Fire Landing, the doors will be able to reopen fully from momentary contact of the Safety Edge or Door Open Button. If the doors are closed, and the car has started to return to the Main Landing, the Safety Edge and the Door Open Button are cut out.
5. The Electric Eye is cut out on Fire Service Phase 1 and 2.
6. The Door Time is shortened to allow the car to respond quickly.
7. The Stop Switch is by-passed, once the car has started to run, by the ESB relay. ESB is held until the doors open at the designated Fire Landing.
8. If the car is on Inspection Operation or is away from the designated Fire Landing, then the Audible Visible will energize.
9. If the car is on Inspection Operation, the operator will have complete control of the car till it is released from Inspection.
10. If the car is on Independent Service, then the audible visible signal will sound. If the car is not returned to normal operation within 30 seconds by the operator, then Independent Service will be automatically cut out, and Fire Service will be initiated. If the car is at the designated landing, or the car is running, then Independent Service is cut out immediately, and Fire Service is initiated.
11. Once Fire Service is initiated, it is necessary to turn the hall Fire Switch to Bypass in order to reset Fire

Service. Cycling the power will not cancel Fire Service, even if the Smoke Sensors are reset.

12. Fire Service in the Hall (Phase 1) may be reset even though the car is still being operated on Phase 2 by a fireman in the car. This allows cars in a group to be returned to automatic operation while one or more cars are being used by the Fire Department for cleanup operations.

NOTE 2: The operation may vary depending on the applicable codes, and particular job requirements.

FIRE SERVICE PHASE 2, (CAR)

Fire Service Phase 2 is initiated when the car is on Fire Service Phase 1, has stopped at the designated Fire Landing and the Car Fire Switch is turned to the On position. Fire Service Phase 2 is held until the car has returned to the Main Landing, the doors are open, and the Car Fire Switch is turned to Off.

NOTE 3: Operation on Fire Service Phase 2 may vary depending on the applicable codes. The operation described here is the standard ANSI National Code.

On Fire Service Phase 2 the following changes in operation occur:

1. The Stop Switch By-pass is cancelled.
2. The Car Calls are re-activated. All Car Calls are cancelled each time the car stops, or when the Fire Call Cancel Button is pressed, or when the doors are fully open and the Car Fire Switch is turned to Hold, or when the doors start to open.
3. The doors are opened by constant pressure on the Door Open Button. If the Door Open Button is released before the doors are fully open, the doors will re-close. If the doors are opened fully, they will stay open until closed by the Door Close Button. The doors are closed from the fully open position by constant pressure on the Door Close Button. If the Door Close Button is released before the doors are fully closed, the doors will re-open fully.
4. If Fire Service Phase 1 is still on, and the doors are fully open, and the car is not at the designated fire landing, and the Car Fire Switch is turned to the Off position, then the doors will automatically close. Once the doors are fully closed, Fire Service Phase 2 is cancelled, and the car will return to the designated fire landing on Fire Service Phase 1. The Stop Switch will be bypassed during the return to the designated landing.
5. If the Car Fire Switch is turned to the Hold position, and the doors are fully open, then all Car Call Buttons and the Door Close Button will be cut out, and the car will remain at the floor with the doors open, until the Car Fire Switch is turned to On or Off.
6. If Fire Service Phase 1 is not on, and the doors are fully open, and the car is not at the designated fire landing, and the Car Fire Switch is turned to the Off position, then the car will operate as if the Car Fire Switch were in the Hold position. That is the doors will remain open and the Door Close Button and Car Call Buttons will be cut out. The Car Fire Switch must be turned back to the On position and the car must be returned manually to the designated fire landing. If the car is at the designated fire landing, and the doors are fully open, and the Car Fire Switch is turned to the Off position, then Phase 2 operation is cancelled and the car will return to normal operation.
7. Fire Service Phase 1 can be reset even though the car is on Fire Service Phase 2.

2.2 INDEPENDENT SERVICE

Independent Service will give an operator in the car complete control of the running of the car by means of the Car Call Buttons, and also of the closing of the doors. Hall calls will NOT be cut out, but they will not be answered. The Independent Service Switch energizes the Independent Service Input to the PLC. This initiates Independent Service operation.

On Independent Service the following changes in operation occur:

1. The Hall Calls do not select a direction.
2. The Hall Calls do not initiate slowdown.

3. The Hall Calls are not cancelled when the car stops.
4. All Car Calls are cancelled each time the car stops.
5. The doors are held open by the PLC until a Car Call Button or the Door Close Button is pressed. The button must be held until the doors have closed fully and the car has started to run, or the doors will re-open.
6. The Direction Lanterns are cut out.
7. If Fire Service is initiated and the car is at a floor with the doors open, the Audible Visible will energize. After 30 seconds, Independent Service will be cut out, and the car will return to the Main Landing (subject to applicable codes). If the car was running, or the car was at the Main Landing, then Independent Service is cut out immediately, and the car goes on Fire Service.

2.3 DIRECTION LANTERNS

Direction Lanterns indicate which direction the car is sets to travel as it stops. This is usually selected by the presence of other calls in the system, or the fact that the car has stopped to answer a hall call that has established a specific direction.

NOTE 1: If the car is stopping for a car call only, and there are other calls in the system, then the direction will be held by the other calls. If no other calls are registered, then a Car Call will not energize a direction lantern.

NOTE 2: If Car Direction Lanterns are used, the PLC energizes the lanterns when the car has stopped and the doors have started to open. If Hall Lanterns are used, the Lanterns will energize when slowdown is initiated. If the Lantern is the result of the car stopping for a Hall Call, and there are no other calls registered, then the Lantern will remain energized until the expiration of the door time, and the doors have started to close. If there are further calls in the direction of travel, then the Lantern will remain energized until the doors are fully closed.

NOTE 3: If 2 Stroke Down lanterns are provided, the PLC energizes the Lantern for 0.5 seconds, then cuts out the Lantern for 0.5 seconds, then turns the Lantern on again.

2.4 LOAD WEIGHING BYPASS

The Load Weighing Bypass feature makes the car bypass Hall Calls when the car is full. This prevents delays from the car stopping for passengers, when it is already fully loaded. The car will stop for car calls till the car is empty enough to accept further passengers, then it will start answering Hall Calls again. The Load Weighing Switch can initiate Load Weighing only when the doors are closing while the car is preparing to start a run. This prevents a false signal from the Load Weighing device from initiating Load Weighing while the car is accelerating or running.

NOTE 1: On computerized group systems, Load Weighing will also cancel any remaining door time at the Main Landing, allowing a fully loaded car to leave immediately.

2.5 DUPLEX FEATURES

The Duplex System will keep one car at the Main Dispatch Landing, or Lobby, as the Lobby Car, and allow the other car, or the Free Car, to stop at it's last call. The Lobby Car will answer calls at the Lobby, and the Free Car will answer all other calls. Once the Lobby Car leaves the Lobby it will answer all calls it passes. The Lobby Car may leave the lobby to assist the Free Car under various load conditions as described below under Start Control.

COMMON CIRCUITS

Several circuits on a Duplex System need to be energized when either car is on. These include the Hall Calls, Fire Service, and some other circuits that may be required for a particular job (such as Emergency Power, Hospital Service, etc.). These circuits get their power from either car by means of the VR relay.

1. If Elevator A is powered up, then VR is energized. VR Normally Open contacts connect the common feed to the 115VAC for Elevator A.

2. If Elevator A is not powered up, then VR is not energized. VR Normally Closed contacts connect the common feed to the 115VAC for Elevator B.

NEXT CAR UP

When both cars are at the Lobby, the first car to arrive there is designated as the Next Car Up. The Next Car Up will answer Lobby Hall Calls, and will also be the first to leave the Lobby in response to calls away from the Lobby.

CAR START

The Car START feature controls when the car will respond to registered Hall Calls by controlling the internal direction circuits. When the START circuit is energized the car will immediately begin to respond to Hall Calls.

The START circuit is energized if any of the following conditions are true:

1. Any Car Call is registered, or
2. The car is away from the Lobby, or
3. The car is running fast speed, or
4. The car is not in normal group operation, or
5. The other car is not in normal group operation, or
6. The other car has a call behind it, or
7. The car is Next, and there are two cars at the Lobby, or
8. Hall Call(s) have been energized for a preset time period.

HOMING

If there are no cars at the Main Dispatch landing, the first free car will home, or return, to the Main Dispatch Landing. This is accomplished by internal circuits in the PLC

A car will home if the following conditions have been met for 2 seconds:

1. The car is in group operation (not on Inspection, Independent Service, Fire Service, Load Weighing etc.).
2. The Stop Sw is not thrown.
3. The car is not stuck.
4. The doors are closed.
5. The car is not at the Main Dispatch Landing.
6. The car is not running.
7. The other car is in group operation.
8. The other car is not at the Main Dispatch Landing.
9. The other car is not running.
10. The other car is not homing.

2.6 DUPLEX COMMUNICATION

Communication between each car is achieved through the Input and Output Modules. That is, the Communication Outputs on Elevator A are connected to the Communication Inputs on Elevator B, and similarly the Communication Outputs from Elevator B are connected to the Communication Inputs on Elevator A. A Multi-plexing system is used to allow the communication of more than just the 8 Input/Output points. This operates as follows.

The Output Point 1 turns on and off regularly to sequence the data transfer. The program now can transmit two pieces of data on each output point, one piece when Point 1 is ON and one piece when Point 1 is OFF. The Microprocessor receiving data will monitor Point 1, and check the status of each other Communication Point just

after Point 1 goes ON and also just after Point 1 goes off. If Point 1 is not going on and off, then the program assumes the other Microprocessor is out of service.

COMMUNICATION DATA:

If Point 1 is ON...

- And Point 2 is ON, the car is CANCELLING UP HALL CALLS.
- And Point 3 is ON, the car is stopped at the MAIN LDG.
- And Point 4 is ON, the car is NEXT at the MAIN LDG.
- And Point 5 is ON, the car has NO CALLS BEHIND IT (Back Calls).
- And Point 6 is ON add 1 to determine FLOOR POSITION.
- And Point 7 is ON add 4 to determine FLOOR POSITION.
- And Point 8 is ON add 16 to determine FLOOR POSITION.

If Point 1 is OFF...

- And Point 2 is ON, the car is CANCELLING DOWN HALL CALLS.
- And Point 3 is ON, the car is on FIRE SERVICE PHASE 2.
- And Point 4 is ON, the car is HOMING, RUNNING, or at the MAIN LDG.
- And Point 5 is ON, the car is IN SERVICE.
- And Point 6 is ON add 2 to determine FLOOR POSITION.
- And Point 7 is ON add 8 to determine FLOOR POSITION.
- And Point 8 is ON add 32 to determine FLOOR POSITION.

NOTE 1: The Car Position, Points 6-8, is in Binary code. To determine the car position, add the landing values together. For example, if the car communication lights for Binary 1 and Binary 2 are both on, then the car is at the 3rd landing. In some cases the Binary code used will be the same as that used for the Position Indicator outputs. In this case decode the floor value by consulting the chart on the schematic.

NOTE 2: If the Data light (Points 2-8) is flashing in sequence with Point 1, then the Data from the FIRST GROUP is true. If the Data light (Points 2-8) is flashing out of sequence from Point 1, then the Data from the SECOND GROUP is true. If the Data light (Points 2-8) is on all the time, then the Data from the first and second groups is true.

NOTE 3: This description applies to the operation of the Inputs and the Outputs. The Outputs will show the status of the Microprocessor for that Elevator, and the Inputs will show the status for the other Elevator.

2.7 OPEN LOOP REGULATOR OPERATION

The WESS Regulator controls the Generator Shunt Field, Hoistmotor Field, and Brake. The speed of the car is controlled by the Hoistmotor Armature voltage, which is determined by the Generator Armature output, which is determined by the Generator Shunt Field voltage. The regulator controls the output voltage to the Generator Shunt Field according to the control circuit signals, such as the direction selection contacts, and the speed reference contacts.

WESS REGULATOR OPERATION

UP RUN (Down direction is similar). (See also Section 1.6)

1. The car is about to run up. The MG Set is running. The doors are closed, and all other Safety Devices are closed.
2. The PLC turns on the Up Run Output (U1-2 relays), Fast Speed Run Output (FS and FSX relays), and One Floor Run Output (1FR relay), if used.

3. U, P, PX, UDT, UDTX, BK1, BK2 energize, and SU de-energizes.
4. SU, BK1 and BK2 open the Generator suicide circuit.
5. BK1 and BK2 allow the Brake to lift under the control of the regulator.
6. U applies power to the GFC Regulator Hoistmotor Field Power Supply, terminal G3; and direction selection circuit, terminal G7 (G8 for down). The Hoistmotor Field voltage rises from standing voltage to maximum (approximately 200VDC).
7. FSX and 1FR (if used) lock out Approach Speed, terminal G12. PX pulls in just after the rest of the run relays due to the UDT contact in series with its coil. This allows the FSX normally closed contact in the Approach Speed circuit (terminal G12) to open before the Speed Selection circuit is energized. This prevents a bump at the start of the run.
8. P allows the Soft Stop Capacitor, GFC2, to charge from terminal G6.

ACCELERATION (See also Section 1.6)

1. 1FR (if used) and FSX close a circuit between G9 and G13 or G15 on the GFC Regulator. This selects the speed that the regulator will ramp to. The output to the Generator Shunt Field will gradually rise, and the output to the Hoistmotor Field will weaken proportionally, as the car reaches full speed.
2. As the Generator Shunt Field voltage rises, the Generator Armature output voltage also rises, causing the Hoistmotor to accelerate.
3. The acceleration rate is determined by the adjustment of the GFC Regulator. Refer to the GFC Manual for complete adjustment instructions.
4. The speeds that the car will reach on a One Floor or Multi-floor Run are determined by the settings on the speed pots on the GFC Regulator.

NOTE 1: Adjust the High Speed setting to produce maximum rated voltage on the Generator Shunt Field, then adjust the Hoistmotor Field weakening to achieve contract speed. Adjust the One Floor Run speed to achieve the optimum run on the shortest one floor run. The deceleration rates for One Floor Runs and Multi-floor Runs should be the same.

NOTE 2: If the car is going on a One Floor Run, then FSX relay will drop out before the car reaches one floor run speed. This allows the car to ramp to the correct speed, without a bump in the acceleration pattern.

DECELERATION (See also Section 1.6 and 1.7)

1. Slowdown is initiated at the appropriate floor change/slowdown point.
2. The PLC de-energizes FSX and/or 1FR outputs.

NOTE 3: On a One Floor Run, FSX de-energizes after the car has run for one second (when the Advancing Floor Relays automatically advance) and 1FR remains energized to allow the car to accelerate to One Floor Run Speed.

3. The GFC Regulator reduces the Generator Shunt Field voltage, and raises the Hoistmotor Field voltage, causing the car to decelerate.
4. FSX and 1FR relays activate the Leveling Switches.
5. The car slows down to Approach Speed.

STOPPING (See also Section 1.6)

1. The car reaches the Leveling Target and energizes the Up Level Switch.
2. The Up Level Switch energizes UL and LV and the PLC Up Level Input. LV selects the Leveling Speed reference, and the car ramps to Leveling Speed. FSR relay is energized on a floor-to-floor run, so the car goes to level speed, not relevel speed.
3. The car rides onto the Low Level/Door Zone Switch and energizes the Low Level/Door Zone Input and LL

(or DZ) relay. LL (or DZ) locks out the faster speed reference signals (terminals G12, G13, G15) to prevent a shot of acceleration when the car stops and LV drops out.

NOTE 4: Sufficient slowdown distance should be allowed for the car to reach Leveling Speed before it rides off the Leveling Target and attempts to stop. This allows for a more controlled stop.

4. The car rides off the Up Level Switch which de-energizes UL and LV relays and the Up Level Input.
5. The PLC de-energizes the Up Run Output, which de-energizes up run relays. U, P, PX de-energize immediately.
6. The capacitance stored in GFC2 capacitor is applied across the Generator Shunt Field, to provide an electric stop. This allows for a soft stop, while the brake is setting.
7. The GFC Regulator drops the voltage to the Brake, causing the brake to drop softly.
8. After a brief time delay (approximately 1 second) UDT and UDTX will de-energize. This de-energizes BK1 and BK2, and energized SU. The suicide circuit is now completely closed, and the brake circuit opened.

NOTE 5: The suicide circuit connects the Generator Shunt Field across the Generator Armature in such a way as to apply the residual Generator Armature voltage across the Generator Shunt Field so that it is cancelled, or suicided. This is a very important circuit since it involves the fail- safe operation of the elevator. The circuit should be checked periodically for proper operation. The contacts in the suicide circuit should be checked regularly for pitting or wear.

NOTE 6: A Shutdown Timer in the PLC will shut the car down if it runs for more that 30-60 seconds without passing a floor change point (Synchronous or Advancing). The car doors will operate, but the car will not move until the timer is reset by cycling the power, or cycling the Inspection Switch.

NOTE 7: A Leveling Cutout Timer in the PLC cuts out leveling after 15 seconds. The car will then stop, open the doors if it is in the Door Zone, then continue to run in response to other calls.

RELEVEL (See also Section 1.8)

The sequence on a relevel is the same as a normal run, except the FSR relay is not energized, and the PLC prevents the fast speed outputs from energizing, so the speed is set to relevel speed, since terminal G11 is energized.

M.G. SET OPERATION - START

The starting of the M.G. set is normally initiated by MGP relay. Any demand, or anticipated demand, for the elevator will energize MGP, which then initiates the Start sequence of the M.G. set. When the M.G. set is up to speed, the car can run.

Any of the following conditions will cause the PLC to energize MGP relay:

1. The car is on Inspection Operation, OR
2. The car is on Fire Service Phase 2, OR
3. The car moves onto one of the Leveling Switches, OR
4. A direction is selected by a call being registered, OR
5. The doors open in response to a call.

When MGP energizes the MG Set will start as follows:

1. MGP energizes MGX which energizes MG, which energizes STR.
2. STR starts the M.G. set in the Y (or Star) configuration.
3. After the time delay set by RUXP timer, which should be sufficient to allow the M.G. set to get up to speed, RUXP timer energizes RUX.
4. RUX de-energizes STR and energizes RU.

5. RU connects the M.G. set in the Delta configuration.
6. RU auxiliary contact energizes FLR, which closes the Up and Down Run safety circuit, allowing the car to run when the rest of the safety circuit is closed.

STOPPING THE M.G.SET

1. After there has been no demand for the elevator for 5 minutes as set by an internal timer in the PLC, MGP de-energizes.
2. MGP de-energizes MGX, MG, RUX.
3. MG and RUX de-energize RU, and the M.G. set stops.

NOTE 1: The MG set may be manually turned on or off by the toggle switches on the controller. Note that the MG ON switch will keep the MG set on constantly. The MG OFF switch will stop the MG set even if the MGP relay is energized. The second pole of the MG OFF switch cuts out the SAF relays, thus turning off power to the WESS Regulator.

NOTE 2: The Reverse Phase Monitor, MG Set Drive Motor Overload, and Loop Overload must remain in the normal condition (contacts closed). If any of these devices open, this will drop MGX relay, which will drop MG and RUX and stop the MG set.

NOTE 3: FL, Hoistmotor Field Loss Relay, must be energized when the car is sitting idle. If it opens then there is a problem with the GFC Regulator power supply to the Hoistmotor Field, or there is a problem with the Hoistmotor Field itself.

NOTE 4: A fan is provided next to the GFC Regulator to keep it cool. It is vital that the GFC Regulator be kept at a reasonably cool temperature for reliable operation. If the ambient temperature in the machine room is high, or the duty cycle of the elevator is high, it may be advisable to keep the fan on at all times. This can be done by jumping terminal FAN, located next to the GFC Regulator, to terminal 1 on the main terminal strip.

2.8 CLOSED LOOP REGULATOR OPERATION

The IPC Closed Loop Regulator controls the Generator Shunt Field. The speed of the car is controlled by the Hoistmotor Armature voltage, which is determined by the Generator Armature output, which is determined by the Generator Shunt Field voltage. The regulator controls the output voltage to the Generator Shunt Field according to the control circuit signals, such as the direction selection contacts, and the speed reference contacts. The Generator Series Field is NOT USED with the IPC Regulator, and should be disconnected.

Refer to the IPC Manual for the D-1029 Bi-Directional Field Regulator for a complete description of operation of the regulator, and for detailed set-up instructions.

REGULATOR OPERATION

UP RUN (Down direction is similar). (See also Section 1.6)

1. The car is about to run up. The MG Set is running. The doors are closed, and all other Safety Devices are closed.
2. The Hoistmotor Field is strengthened when the doors start to close, and a direction is selected. HFP energizes HF1 and HF2, and HFX is delayed by timer HFP for 1.5 seconds. HFX prevents FLR from energizing until the Hoistmotor Field has been strengthening for the preset time. This allows the Hoistmotor to start with full torque.
3. When FLR energizes, the PLC energizes U and FS (and 1FR, if used) outputs.
4. The running contactors (P, PX, UDT, UDTX, BK1, BK2) energize, and SU de-energizes.
5. SU and SUX open the Generator suicide circuit.
6. BK1 and BK2 allow the Brake to lift.
7. PX puts the regulator into the Run mode, and SUX and PZ apply power to the regulator field power supply

input.

NOTE 1: PX will energize slightly before PZ, so that the internal contactor in the regulator does not switch the power to the Generator Shunt Field, but PZ does. Similarly, when the car stops, PZ will de-energize slightly before PX so that PZ breaks the power to the Generator Shunt Field instead of the regulator's internal contactor. This considerably extends the life of the regulator's internal contactor.

ACCELERATION (See also Section 1.6)

1. 1FR (if used) and FS (or 2FR) selects the speed that the regulator will ramp to. The output to the Generator Shunt Field will gradually rise.
2. As the Generator Shunt Field voltage rises, the Generator Armature output voltage also rises, causing the Hoistmotor to accelerate.
3. The acceleration rate is determined by the adjustment of the IPC Regulator. Refer to the IPC Manual for complete adjustment instructions.
4. The speeds that the car will reach on a One Floor or Multi-floor Run are determined by the settings on the speed pots on the IPC Regulator.
5. As the Generator output voltage approaches maximum, the FW relay will energize. This will weaken the Hoistmotor Field to the "running" value, and allow the car to reach contract speed.

NOTE 2: Use the lowest tap on the GFCXF transformer that will still allow the required Generator Shunt Field voltage to achieve maximum speed. This prevents the Generator Shunt Field from being given too much voltage.

NOTE 3: Adjust the resistor RS to obtain the required Generator Shunt Field current to run the car in the up direction with a full load at rated speed.

NOTE 4: Adjust the One Floor Run speed to achieve the optimum run on the shortest one floor run. The deceleration rates for One Floor Runs and Multi-floor Runs should be the same.

NOTE 5: If the car is going on a One Floor Run, then FS relay will drop out before the car reaches one floor run speed. This allows the car to ramp to the correct speed, without a bump in the acceleration pattern.

DECELERATION (See also Section 1.6 and 1.7)

1. Slowdown is initiated at the appropriate floor change/slowdown point.
2. FS (or 2FR) and/or 1FR de-energize.

NOTE 6: On a One Floor Run, FS de-energizes after the car has run for about 0.5 seconds, and 1FR remains energized to allow the car to accelerate to One Floor Run Speed.

3. The IPC Regulator reduces the Generator Shunt Field voltage causing the car to decelerate.
4. HF2 strengthens the Hoistmotor Field.
5. FS (or 1FR) activates the Leveling Switches.
6. The car slows down to Approach Speed.

STOPPING (See also Section 1.6)

1. The car reaches the Leveling Target and energizes the Up Level Switch.
2. The Up Level Switch energizes UL and LV. LV selects the Leveling Speed reference, and the car ramps to Leveling Speed.
3. The car rides onto the Low Level/Door Zone Switch and energizes the LL relay.

NOTE 7: Sufficient slowdown distance should be allowed for the car to reach Leveling Speed before it rides off the Leveling Target and attempts to stop. This allows for a more controlled stop.

4. The car rides off the Up Level Switch which de-energizes UL and LV.

5. The PLC de-energizes the run output (U), which de-energizes BK1, BK2 immediately, and the Brake drops.
6. The speed signals to the drive are disabled, so the drive produces an output that will hold the car at zero speed. This allows the brake to set while the car is still held under control.
7. After a brief time delay (approximately 1 second) UDT and UDTX will de-energize. This de-energizes SUX and SUY. The suicide circuit closes.
8. SUX de-energizes PY and PZ, thus opening the power to the Generator Shunt Field supply. PX is held slightly, to allow the regulator's internal contactor to drop last without any load.

NOTE 8: The suicide circuit connects the Generator Shunt Field across the Generator Armature in such a way as to apply the residual Generator Armature voltage across the Generator Shunt Field so that it is cancelled, or suicided. This is a very important circuit since it involves the fail- safe operation of the elevator. The circuit should be checked periodically for proper operation. The contacts in the suicide circuit should be checked regularly for pitting or wear.

NOTE 9: A Shutdown Timer in the PLC will shut the car down if it runs for more that 30-60 seconds without passing a floor change point (Synchronous or Advancing). The car doors will operate, but the car will not move until the timer is reset by cycling the power, or cycling the Inspection Switch.

NOTE 10: A Leveling Cutout Timer in the PLC cuts out leveling after 15 seconds. The car will then stop, open the doors if it is in the Door Zone, then continue to run in response to other calls.

NOTE 11: The OSP relay determines what level of overspeed is acceptable. With OSP energized, an overspeed will occur at 110% of contract speed. OSP de-energizes when the car doors are open and the car is in the Door Zone, so that the overspeed limit is 10% of contract speed.

NOTE 12: A regulator reset is provided by means of RST relay. If the ENX relay de-energizes, due to a regulator fault, then after the car has stopped, the PLC energizes RST, closing the reset circuit to the regulator. The reset signal is held until the regulator resets, and ENX energizes. If the automatic reset makes four resets in a 15 minute period, then the car will be shutdown, since there is a serious problem with the Regulator or its adjustments.

RELEVEL (See also Section 1.8)

The sequence on a relevel is the same as a normal run, except the RL relay is not energized. RL does not bypass the RRL resistor in the Generator Shunt Field circuit, so RRL limits the output from the regulator, to restrict the car speed to a safe minimum. UL/DL prevents the fast speed relays from energizing.

M.G. SET OPERATION

The MG Set operation is the same as described for the Open Loop. See Section 2.7, above.

IPC OPEN LOOP OPERATION

The operation is similar to that described for the WESS Open Loop Regulator, except that the Hoistmotor Field and Brake are controlled separately.

2.9 SCR STATIC DRIVE OPERATION

The SCR Static Drive controls the Hoistmotor Armature and Field. The drive uses tachometer feed-back to move the car in response to the Speed Reference Input voltage, that is supplied by the S-curve generator. Refer to the Drive manual for details of the theory, operation, adjustments, and start-up procedures for the drive. The jumpers shown on the schematic have already been installed on the drive. Refer to the schematic for start-up notes and a description of the function of the adjustments on the S-curve generator.

When power is applied to the Drive Power Input terminals from the Main Line fused disconnect switch, the drive turns on and performs its diagnostic self-checks. It then turns on the fault relay, indicating it is ready to run, which closes the safety circuit on the main controller. This allows the direction run relays on the main controller to energize when a direction is established and the doors are closed. When the Direction Run relays energize, the UDT and UDTX relay contacts close the start signal on the Drive. This will energize the main contactor on the

Drive. An auxiliary contact of this contactor allows the Brake contactors to lift, so that the Drive is now controlling the movement of the car. The Drive will cause the car to run in the direction and at the speed set by the Speed Reference Input from the D-280 S-curve generator. The S-curve generator produces a ramped and rounded profile determined by the speed, acceleration and deceleration settings of its pots. See the schematic for a description of each pot. The following description covers all SCR Static Drive installations. Specific notes for a particular installation will be found in the adjustment sheets that are part of the schematic for that job, and also in the Drive Manual provided with the job.

DRIVE OPERATION

UP RUN (Down direction is similar). (See also Section 1.6)

1. The car is about to run up. The Drive is on. The doors are closed, and all other Safety Devices are closed.
2. The PLC turns on the Up Run Output (U1-2, UX relays), Fast Speed Run Output (FS relay), and One and Two Floor Run Output (1FR, 2FR relays), if used.
3. The run relays will energize UDT and UDTX which give a contact closure to the Enable circuit on the drive. This energizes the main drive DC contactor.
4. An auxiliary of this contactor closes indicating the drive loop is closed and that the drive is now controlling the motor, and will cause it to run in the direction and at the speed set by the speed reference input voltage signal received at terminals TB1-21 and TB1-23.
5. When the drive contactor closes, and the Loop Closed signal is sent back to the controller and allows BK1 and BK2 to lift the Brake.
6. The Hoistmotor Field current rises from standing to running current. The Hoistmotor field supply on the drive is in the Current Regulating mode, so the drive will adjust the voltage to give the required current in the field, thus providing the same amount of torque under any temperature condition.
7. The speed relays (FS, 1FR, 2FR etc.) close a contact between TB3-21 and TB3-22 to 27 on the S-curve generator. This sets the speed that the S- curve generator will ramp to.
8. UDTX closes the S-curve Run signal between TB3-35 and TB3-36 (37 for down). The S-curve now starts to increase the voltage output at terminals TB2-9 and TB1-3 from zero to the voltage set by the speed contact. The profile of the output is determined by the settings on the S-curve generator, including the rounding pots P1-P4, the speed pots SP1-SP5 and the appropriate acceleration or deceleration pots, ACC1-ACC2 or DCC1-DCC2.

ACCELERATION (See also Section 1.6)

1. The speed relays close a circuit between TB3-21 and TB3-25, TB3-26 or TB3- 27, depending on the selected speed. This selects the speed that the S- curve generator will ramp to. The output of the S-curve will gradually rise, causing the speed reference signal to the drive speed reference input terminals to rise.
2. As the speed reference signal to the drive rises, the drive increases the Hoistmotor Armature output voltage, causing the Hoistmotor to accelerate.
3. The acceleration rate is determined by the adjustment of the S-curve generator and the drive acceleration rate. The drive acceleration and deceleration pots should be set to give a fast rate that will not interfere with the rate set by the S-curve generator. See note below.
4. The speeds that the car will reach on a One Floor or Multi-floor Run are determined by the settings on the speed pots on the S-curve generator.

NOTE 1: The maximum output voltage of the S-curve generator is 10VDC. Adjust the Max Speed pot on the drive to get contract speed when the speed reference signal is 10VDC. Check that the Hoistmotor voltage/current is at the proper value to achieve contract speed. Adjust the One Floor Run speed to achieve the optimum run on the shortest one floor run. The deceleration rates for One Floor Runs and Multi-floor Runs are be the same.

NOTE 2: If the car is going on a One Floor Run, then FS relay will drop out before the car reaches one floor run speed. This allows the car to ramp to the correct speed, without a bump in the acceleration pattern.

DECELERATION (See also Section 1.6 and 1.7)

1. Slowdown is initiated at the appropriate floor change/slowdown point.
2. The PLC de-energizes the fast speed relays (FS, 1FR, 2FR etc.).

NOTE 3: With multi-floor circuitry, on a One Floor Run, FS de-energizes after the car has run for one second (when the Advancing Floor Relays automatically advance) and 1FR remains energized to allow the car to accelerate to One Floor Run Speed. Two floor runs are similar.

3. The S-curve generator ramps the output voltage down to the setting for Approach Speed, causing the car to decelerate. The deceleration rate is set by DCC1 or DCC2 pots on the S-curve generator.
4. The car slows down to Approach Speed.

STOPPING (See also Section 1.6)

1. The car reaches the Leveling Target and energizes the Up Level Switch.
2. The Up Level Switch energizes UL and LV and the PLC Up Level Input. LV selects the Leveling Speed reference, and the car ramps to Leveling Speed.

NOTE 4: Sufficient slowdown distance should be allowed for the car to reach Leveling Speed before it rides off the Leveling Target and attempts to stop. This allows for a more controlled stop.

3. The car rides off the Up Level Switch which de-energizes UL and LV relays and the Up Level Input.
4. The PLC de-energizes the Up Run Output, which de-energizes up run relays. The UD relay now shorts the speed reference input to the drive. This commands the drive to hold the car at zero speed while the brake sets, providing a soft stop.
5. BK1 and BK2 de-energize, causing the brake to set.
6. After a brief time delay (approximately 1 second) UDT and UDTX will de-energize. This stops the drive, de-energizing the drive contactor and opening the drive loop.

NOTE 5: A Shutdown Timer in the PLC will shut the car down if it runs for more than 30-60 seconds without passing a floor change point (Synchronous or Advancing). The car doors will operate, but the car will not move until the timer is reset by cycling the power, or cycling the Inspection Switch.

NOTE 6: A Leveling Cutout Timer in the PLC cuts out leveling after 15 seconds. The car will then stop, open the doors if it is in the Door Zone, then continue to run in response to other calls.

RELEVEL (See also Section 1.8)

The sequence on a relevel is the same as a normal run, except the PLC prevents the fast speed outputs from energizing, so the speed is set to level speed.

DYNAMIC BRAKING

If Dynamic Braking is used, the Dynamic Braking contactors, piloted by DBP relay, will be energized whenever the drive control power is on. The contacts of the Dynamic Braking contactors connect the Hoistmotor Armature to the drive as usual. If there is a fault in the drive, and the Drive Fault contact opens, then DBP will de-energize the Dynamic Braking contactors, and the current circulating in the Hoistmotor Armature will be diverted through the Dynamic Braking Resistors. This will decelerate the car in addition to the action of the Brake. Note that the effect of the Dynamic Braking will vary depending on the current in the Armature just before Dynamic Braking is initiated.

IMPORTANT DRIVE NOTES

1. IMPORTANT NOTE: The mounting and driving mechanism for the tachometer is extremely critical. It will have a tremendous effect on the performance and smoothness of the drive. It is vital that there be no slip, and no oscillations in the tachometer.

2. **IMPORTANT NOTE:** The wiring to the tachometer must be done with shielded twisted pair wires. The shield must be connected to TCC. Do not ground the shield.
3. **IMPORTANT NOTE:** See the specific installation instructions provided with the controller for the particular drive used on each job.
4. **IMPORTANT NOTE:** The speed reference circuit is a low voltage circuit that is subject to noise from other electrical components. All wiring in the speed reference circuit is done with twisted pair wiring to reduce the possibility of interference. Extreme care should be taken to keep all low voltage signals away from other wiring.
5. The Accel and Decel pots on the drive should be adjusted to be equal, and to give a deceleration rate that is faster than the S-curve generator, but not fast enough to cause the car to slip traction. The rate set by these pots will be used when the car stops at a floor (that is when it rides off the leveling switch, and before the brake sets). Adjust the dropping of the brake and the setting of these pots to give a soft stop. Note: These pots will also control the deceleration rate when the car stops on inspection operation, and if the S-curve generator output immediately goes to zero, which could happen on a safety stop, or with a hardware malfunction of the S-curve generator.

IPC D-280 S-CURVE GENERATOR ADJUSTMENTS

The speed of the drive is controlled by the speed reference voltage input signal at terminals TB1-21 and TB1-23. A signal of +10vdc produces full speed up, -10vdc produces full speed down. The signal is produced and controlled by the IPC D-280 S-curve generator. The maximum output of the D-280 is ± 10 vdc. The maximum speed pot on the drive should be adjusted so that when the D-280 is producing ± 10 vdc the car is at contract speed. The following adjustments are available on the D-280:

1. Rounding pots p1-p4. These pots adjust the rate of change of acceleration or deceleration. This affects the motion of the car when it first starts (p1); reaches the preset speed (p2); starts to decelerate (p3); and decelerates to a slower preset speed (p4). Turning p1-p4 clockwise makes the curve sharper, for a harder and faster ride. Turning p1-p4 counter-clockwise makes the curve smoother, giving a softer and slower ride. It is recommended that the pots be set fully clockwise, then backed off as required for a smooth ride. The diagram on the S-curve board helps visualize which pot affects which part of the movement of the car.
2. Speed Pots SP1-SP5. These pots determine the speed output that the D-280 will ramp to. A speed is selected by a contact closure from the speed common (TB3-21) to the desired speed terminal (TB3-22 for SP1, TB3-23 for SP2, etc.). Only one speed can be selected at any given time. The D-280 will ramp from its previous speed to the new speed each time the speed is changed. Turning the speed pots SP1-SP5 clockwise will increase the speed. Refer to the schematic to see the exact function of the speed pots.

SP1 - Speed Setting #1. Limited to 15% of maximum speed. It sets the leveling speed. normal leveling speed is 7fpm.

SP2 - Speed Setting #2. Limited to 30% of maximum speed. It sets the inspection speed. If a greater inspection speed is desired, the wire in terminal TB3-22 can be moved to a spare speed point that does not have a limitation of its output (SP4 or SP5, if available). This must NOT be done if the contract speed is over 500fpm, and is not recommended if the contract speed is over 100fpm.

SP3 - Speed Setting #3. This speed is not limited. It sets the Approach Speed, which is an intermediate speed the car will decelerate to when it starts slowdown, and before it reaches the leveling zone. Normal approach speed is 30fpm.

SP4 - Speed Setting #4. This speed is not limited. It normally sets the One Floor Run speed, which is only used if the car cannot reach contract speed when running between the shortest floor. Adjust SP4 to give the desired One Floor Run speed which should be approximately the maximum speed the car can do when travelling between the shortest floor.

SP5 - Speed Setting #5. This speed is not limited. It normally sets the Two Floor Run speed, which is only used if the car cannot reach contract speed in the shortest two floor run. Adjust SP5 to give

the desired Two Floor Run speed which should be approximately the maximum speed the car can do when traveling between the shortest two floors.

HIGH - High or Full Speed is not adjustable. It will produce $\pm 10\text{VDC}$ output from the D-280. Contract speed is achieved by setting the maximum speed pot on the drive.

3. Acceleration and Deceleration pots. These pots adjust the rate of acceleration and deceleration. Turn the pots clockwise for a faster rate. The pots can adjust the ramp time from 1 second (fully clockwise) to 5 seconds (fully counter-clockwise). DCC3 is not used.

DCC1 - Deceleration Rate #1. This adjusts the deceleration rate, or ramp, when the car requires a fast slowdown, such as when the Emergency Stop Switch is thrown. DCC1 should have a faster ramp than DCC2.

DCC2 - Deceleration Rate #2. This adjusts the deceleration rate, or ramp, during normal slowdown, and should be adjusted to give the desired slowdown from full speed. Adjust DCC2 so that there is no bump when going from speeds SP3 to SP1. If a bump is felt, decrease DCC2. If the car overshoots, either increase DCC2 or increase the slowdown distance. DCC2 should have a slower ramp than DCC1.

ACC1 - Acceleration Rate #1. Sets the normal acceleration rate.

ACC2 - Acceleration Rate #2. Sets the Inspection acceleration rate.

STATIC TEST PROCEDURE FOR D-280 S-CURVE GENERATOR.

This procedure can be used to test the IPC D-280 S-curve generator board.

Important: Make sure the car cannot run and the brake cannot lift, by putting the car on Inspection, and opening the safety circuit (open the Emergency Stop Sw, Door Contacts, etc.).

1. Input Voltage Check. Verify that TB1-1(+) to TB1-3 = +15VDC, and TB1-2(-) to TB1-3 = -15VDC.
2. Speed Voltage Check. Unplug ES relay to disconnect the contacts in the speed selection circuit. Connect the test meter to TB3-21(+) and TB1-3(-). Connect the jumpers shown in the following table one at a time, and observe the meter reading. The voltage should be adjusted by the speed pot as shown in the table.

Jump TB3-21 to..	Adjust Speed Pot	Output Voltage
TB3-22	SP1	-1.5VDC
TB3-23	SP2	-3VDC
TB3-24	SP3	0-10VDC
TB3-25	SP4	0-10VDC
TB3-26	SP5	0-10VDC
TB3-27	(not adjustable)	10VDC

1. Ramp Voltage Check. Connect the meter to TB2-9(+) and TB1-3(-) to monitor the D-280 output. Jump TB3-21 to TB3-22 to test speed #1. Jump TB3-35 to TB3-36 to simulate an up run. The Up led on the D-280 should light, and the output voltage at TB2-9 should rise at the rate set by the acceleration pot until the output voltage is the same as the voltage across TB3-21 and TB1-3. When the speed selection jumper (TB3-21) is removed, the Up led will go out and the output at TB2-9 will decrease to zero at the rate set by the deceleration pot. Repeat this procedure for all speeds, using the table above to determine the correct jumpers and pot combinations. Repeat for the down direction, by jumping TB3-35 to TB3-37 to simulate a down run. The Down led should light, and the polarity of the output at TB2-9 will be reversed.

TACH LOSS BOARD OPERATION

The Drive monitors the tachometer to verify it is operating, and will cause the Drive to trip its fault relay if it should fail. In addition, a separate Tach Loss Board is used to provide a completely separate means of failure detection for the tachometer. The Tach Loss Board has inputs from the tachometer and the Armature. It compares the signal from these two sources and will trip its fault relay if the difference exceeds a preset amount. This would indicate a tachometer failure, or that the Drive is not controlling the motor properly. The Tach Loss Board also provides an overspeed function. On normal operation this trips the fault relay if the car speed exceeds 110% of contract speed, but on Inspection operation it trips if the car exceeds 150fpm.

All adjustments to the Tach Loss Board have been set at the factory, based on the motor data supplied for each job. No further adjustments should be required. Refer to the schematic for notes on adjustments if the Tach Loss Board trips during normal operation.

Tach Loss Board LED Outputs.

RED LED comes on for a Tach Loss Fault.

GREEN LED comes on for an Overspeed Fault.

TACH LOSS BOARD ADJUSTMENTS.

TACH CALIBRATION POT. (Connected to TB2 14 and 15 on Tach Loss Board)

The Tach Calibration pot is scaled to match the tachometer voltage when the car is at contract speed. The approximate value can be determined from the following formula:

$$\text{Tach Calibration Pot Resistance} = (1450) / ((\text{Tach Voltage}) - 29) \text{ K OHMS.}$$

If the Tach Loss Board consistently trips the red Tach Loss LED during normal operation, increase the Tach Calibration Pot in 1K increments. If the Tach Loss Board consistently trips the green Overspeed LED, decrease the Tach Calibration Pot in 1K decrements.

ARMATURE CALIBRATION POT. (Connected to TB1 3 and 4 on Tach Loss Board)

The Armature Calibration pot is scaled to match the armature voltage when the car is at contract speed. The correct value can be determined from the following formula:

$$\text{Armature Calibration Pot Resistance} = (40000) / ((\text{Armature Voltage}) - 80) \text{ K OHMS.}$$

If field weakening is used, then a separate adjustment is provided to rescale the Armature Calibration pot during field weakening. This should be adjusted to eliminate Tach Loss faults during field weakening. The correct values can be determined from the following formulae:

$$\text{Armature Calibration Pot Resistance} = (40000) / (((\text{Armature Voltage}) \times (\text{Speed Ratio})) - 80) \text{ K OHMS.}$$

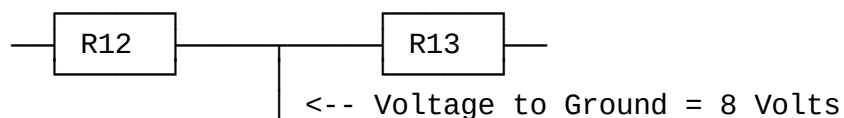
(with Full Field)

where Speed Ratio = (Contract Speed) / (Car Speed with Full Field and Full Armature Voltage)

$$\text{Armature Calibration Pot Resistance} = (40000) / ((\text{Armature Voltage}) - 80) \text{ K OHMS.}$$

(with Weakened Field)

NOTE: A more accurate means of adjusting the Tach and Armature Calibration pots is to adjust them till the voltage at the point between resistors R12/R13 and ground (for Tach Calibration) and between resistors R31/R32 and ground (for Armature Calibration) is equal to 8 volts. (See diagram below).



Tach Calibration point shown. Armature Calibration is similar except measure the voltage between resistors R31 and R32.

OVERSPEED CALIBRATION POT. (Connected to TB2 9 and 11 on Tach Loss Board)

The Overspeed Calibration pot set the percentage overspeed that causes a fault trip. This is 33K Ohms for 110% of contract speed for normal operation. An additional adjustment sets the Overspeed Calibration setting on Inspection operation, or when the car is leveling. This is factory set to trip the overspeed if the car exceeds 140fpm. These adjustments should not require adjustment in the field.

NOTE: Decreasing the Overspeed Calibration pot resistance will increase the point at which an overspeed fault occurs.

3 CONTROLLER ADJUSTMENTS AND INSTALLATION NOTES

NOTE: When sequences are described for one floor all other floors are similar. Refer to the schematic for details on specific Inputs and Outputs, and the exact controller wiring. Refer also to the G.E. Manual for Operating Instructions for the Programmable Logic Controller (PLC).

3.1 ADJUSTMENTS

1. EST - EMERGENCY STOP SWITCH TIMED RELAY. (HIGH SPEED TRACTION ELEVATORS)

Energized when the Emergency Stop Switch in the car is in the "On" or "Run" position. It is a time delay drop out relay, and allows the car to slow down if the Stop Switch is thrown while the car is running. "ES" will de-energize the speed relays or speed circuits, causing the car to start to slow down, but "EST" will hold the direction relays, allowing the car to slowdown normally, before applying the brake. This provides a smoother stop, with less strain on the equipment than an immediate stop would. The time on "EST" should be adjusted by means of the multi-position switch "EST", which changes the amount of capacitance in parallel with the relay coil.

2. UDT and UDTX - CAR RUNNING TIMED RELAYS. (Some TRACTION ELEVATORS)

Energized when the car is running, and held for a short time after the car stops. On M.G. set systems, it allows the Electric Stop to hold the car before the Brake sets, and the suicide circuit closes. On SCR Drive systems, it allows the Drive to hold the car at zero speed while the brake sets.

3. RUXP or TRUP - M.G. SET RUN TIMER. (Used with M.G. sets only.) Energized preset time after the M.G. set starts to run. It will change the connection of the motor from "Y" to "Delta". Recommended setting is 4.8 seconds, no adjustment is necessary.

4. GENERATOR SERIES FIELD SHUNT WIRE. (Used with M.G. sets only.) Adjust to give proper compounding. The Shunt Wire is a coil of 10-14 gauge wire, approximately 6 feet long, located in the Generator junction box (shorten or lengthen wire to change compounding). The Shunt Wire is at the same temperature as the generator, thus compensating for any resistance change due to temperature change of the generator.

5. Refer to the Section 2 for specific information on the various drive systems available. Refer also to the manufacturer's instructions for the regulator or drive system used.

6. Refer to the PLC Manual for instructions on Maintenance and Troubleshooting for the Programmable Logic Controller (PLC)

3.2 STANDARD FEATURES

Each system is programmed for the particular application. Most features are shown on the Title Sheet of the schematic (such as Fire Service, Car or Hall Lanterns, Independent Service, etc.).

The following standard features are provided in the programming:

1. DOOR OPEN FAILURE TIMER - cuts out the Door Open output after 15 seconds, allowing the doors to close if the doors fail to open due to blown fuse, stuck operator, or other cause.
2. ADJUSTABLE DOOR TIME - The doors will remain open for a specific period of time after they have stopped opening, or after a door open device (Door Open Button, Safety Edge, Electric Eye) has been released. At the expiration of the door time, the doors will start to close. The normal Door Time, that is the time that the doors remain open after getting fully open, and before beginning to close, is 5 seconds. This time is adjustable.

The normal Door Time is shortened to 3 seconds if:

- a. The car is stopping for a Car Call only, or
- b. The car is stopping for a Hall Call, and a Car Call Button or Door Close Button has been pressed since the car stopped at the landing.

The normal Door Time is shortened to 1 second if:

- a. The car is stopping for a Car Call only, and the Electric Eye, Safety Edge, or Door Open Button has been energized, or
- b. The Electric Eye, Safety Edge, or Door Open Button has been energized, causing a door re-open, or
- c. The Door Nudging or Load Weighing feature has been activated.

The normal Door Time is shortened to 0.3 seconds on special operations such as Independent Service, Fire Service, etc.

3. DOOR CLOSE FAILURE TIMER - re-opens the doors if they fail to close within 15 seconds. The doors will be held open for 15 seconds, then be allowed to re-close. This prevents the doors from being held under torque if they are unable to close due to a blown fuse, dirt in the tracks or some other cause.
4. DOOR OPEN and CLOSE DELAY - The doors are prevented from trying to close immediately after they have stopped opening, or from trying to open immediately after they have stopped closing, thus reducing the strain on the door operator.
5. DOOR OPEN OR CLOSE FAILURE TIME (DUPLEX OR TRIPLEX) - If the doors fail to open or close properly, the car will be put out of service, if it is part of a Duplex or triplex system.

NOTE: The calls will not be cancelled on a Duplex if the doors are not working properly.

6. STUCK BUTTON TIMER - cuts out a re-open signal from the Car and Hall Calls after 25-40 seconds, if there is another call in the system. This allows the car to respond to other calls.
7. TRAVELLING LANTERN DELAY - The initiation of the Car Direction Lanterns is delayed 1 second until the car has stopped, and the doors have opened enough for the Lantern to be heard outside the car.
8. SHUTDOWN TIMERS - Two shutdown fault timers are normally provided. The Running Shutdown Timer will drop fast speed, then shut the car down 5 seconds later if the car has been running continuously for 25 seconds (adjustable) without passing a floor. The Brake Fault Timer will trip if the Brake Micro Switch Input or other Run Monitor Inputs indicate the car is not running when the PLC thinks it should be, or indicate the car is running when the PLC thinks it should not be. Either timer will remain shutdown until it is reset by momentarily putting the car on "Inspection" or by stopping the PC, or by cycling the Main Line Disconnect. If the car is floor level, or close to floor level when it has shutdown, then the most likely cause is the Brake Fault timer. If the car is between floors, then the most likely cause is the Running Shutdown Timer.

NOTE: Both these timers will cause the car to be shutdown. The cause of the problem should be determined before the car is put back in service.

9. INDEPENDENT SERVICE CUTOFF TIMER - cuts out Independent Service after 30 seconds if the car is stopped with the doors fully open, and Fire Service has been activated.
10. DIRECTION PREFERENCE - Direction Preference for Hall Calls is maintained for 4 seconds after the doors have started to close, allowing a passenger entering the car to have preference in establishing the next direction of travel, if the car had no preset direction.
11. ELECTRIC EYE CUTOFF TIMER - This cuts out the Electric Eye if it has been activated for 15 seconds continuously. The Electric Eye is enabled again after the car has run. This timer is optional, and will be provided only when specified.
12. CAR STUCK - Used on multi-car systems only. The car is put out of service if it has been stuck for over 40 seconds, allowing the other car(s) to answer all calls.

13. HOMING - Homing returns the car to the Main Landing after the car has been inactive for the preset time.
14. HALL CALL HELP OUT TIMER - The car is allowed to leave the Main Floor if the other car of the Duplex is not able to answer all the calls in 90 seconds.

Additional features may be provided as required by the particular job specifications, and as shown on the schematic.

3.3 INSTALLATION NOTES

1. Refer to the Programmable Logic Controller (PLC) User's Manual for a complete description of hardware.
2. The system has been programmed and tested for the specific elevator system, so no further changes should be made without consulting with Virginia Controls. Power connections to all devices have already been made by Virginia Controls.
3. Before applying power to the Programmable Controller, verify that the voltage to terminals 1 and 35 is 110-125VAC. When power is turned on to the Programmable Controller the POWER, OK and RUN lights on the CPU should come on. The CPU memory is PROM (Programmable Read Only Memory), so does not require the battery to maintain it. The battery is required to hold some retentive coils in the CPU during a power failure. The battery has a life of between 2 and 5 years. When it is about to fail, the BATTERY light on the Power Supply module will go on. The battery must now be changed as described in the user's manual.

NOTE: To provide proper warning of a failing battery, the controller may turn on the Shutdown Output when the battery is low. The Shutdown Output, which will also come on if the car shuts down due to running for too long a period of time without passing a floor (see above), may be used to turn on a light to alert building personnel that the battery should be changed. The battery will drain quicker if the power is turned off, so it is recommended that the controller power be left on whenever possible.

4. Field connections should be in accordance with the user's manual (page 3- 39). Refer to the schematic to determine which wires are connected directly to the I/O modules, and which are connected to terminals.

NOTE: It is essential that all wiring is connected to the correct Input or Output point. It may be necessary to temporarily remove a factory wire from one of the I/O modules when connecting the field wiring. If this is done, be sure to return the factory wire to the correct place.

NOTE: It may be easier to connect the field wiring with either the module or the terminal board removed. (see pages 3-34 to 3-39)

NOTE: The terminal numbers do not correspond to the Input/Output reference numbers. The schematic shows the terminals and the reference numbers. The indicator lights show the Input/Output reference numbers. The top line of lights is for Group A Inputs/Outputs, the bottom line is for Group B Inputs/Outputs. See the schematic or module label to match the Input/Output number to the proper terminal number.

5. Refer to the user's manual (pages 3-34 and 3-35) for the proper procedure for removing Input or Output cards. If an Input or Output module fails, it may be possible to temporarily replace that defective module with another module that is used for non-essential functions (such as call register lights), thus providing service to the building while a replacement module is being obtained.

NOTE: The Input and Output modules must be installed in the correct slots. The schematic indicates where each module should be located. Though Input modules may be changed with other Input modules of the same type, and Output modules changed with other Output modules of the same type, an Input module must NEVER be put in a slot allocated for an Output module, and an Output module must NEVER be put in a slot allocated for an Input module.

6. A safety relay interface is provided to prevent dangerous operation due to a failure of the Programmable Controller. It is possible that the programmable controller may turn on an output point, yet the field safety switches may prevent the associated device from energizing. For example, if the Up Run Output energizes, but the Up Normal Switch is open, then the Up Run Valve(s) will not energize.

7. The floor relays and fire service relays are maintained in the CPU memory and are held through power loss. The floor relays may need to be reset when the controller is initially installed. This will be accomplished when the elevator hits any floor switch. With a pulsing type selector, the floor position is reset at either terminal landing when a slowdown switch and the low level switch are energized at the same time.

NOTE: If floor switches are used, they should be maintained at the terminal landings, so that they are energized whenever the car is in the slowdown zone at that landing.

3.4 TROUBLESHOOTING

1. Refer to the User's Manual (chapter 3) for maintenance and troubleshooting procedures. A Hand-Held Programmer is not required for proper operation of the system, though it does aid in troubleshooting the CPU.
2. Troubleshooting with the PLC is similar to any other controller, and has several features to speed up determining the cause of any problem. No special knowledge of the operation of the PLC is required to be able to troubleshoot it. A Hand-Held Programmer is useful but not essential for troubleshooting.
3. Once the system has been installed, and is running properly, the most common problem will be the failure of an Input or Output point. The first step in locating the cause is to determine whether the fault is in the PLC or whether it is in the external wiring. For example, if a Position Indicator Light is not lit, check the Output Module for the appropriate Output Point to determine if the PLC is trying to turn the light on or not. If the PLC Module light is on, then confirm that there is voltage at the Module terminal. If there is voltage at the Module terminal, then the problem is external to the PLC. It could be in the wiring to the Position Indicator, or perhaps the Position Indicator Light has burned out. Similarly with Input points, check that the Input Module light is on, that there is power at the terminal, and if not then the problem is external. If it is determined that the problem is with the PLC, then the terminal block can be unplugged from the module, and a new module should be installed in its place. If this does not correct the problem, the Power Supply, Rack or the CPU module could be faulty. If the CPU fails, it will probably turn off its "RUN" or "OK" light, due to internal checking features. The CPU and other modules can be affected by high transient surges in the power supply, such as the building being hit by lightning. This may damage the CPU, or alter the contents of the program. Cycling the power, and leaving the power off for at least 5 seconds, will cause the CPU to reload the program from the PROM chip, which may correct the problem.

- IMPORTANT -

IF TROUBLESHOOTING ASSISTANCE IS REQUIRED FROM VIRGINIA CONTROLS, GET THE FOLLOWING INFORMATION BEFORE CALLING:

- 1. AN EXACT DESCRIPTION OF THE PROBLEM.**
- 2. THE STATUS OF ALL THE INPUT AND OUTPUT POINTS.**

3.5 FEATURE ADJUSTMENT

Various settings can be changed in the field, such as Door Times, Fire Service Return Landings, Shutdown Times, etc. For a complete description of the Field Adjustment procedure, see the separate instructions for this operation.

NOTE: The procedure may be different for each job, so do not assume that the instructions for a previous job will apply to another job.

RESET FACTORY DEFAULT SETTINGS.

If the operation of controller is strange, such as the door times being extremely short, the car not returning to the correct Fire floor, then the factory default values should be reset. The adjustable values are reset to the factory

settings whenever the Field Adjust Mode is initiated from a power off condition. The jumpers described below can probably be made to terminals 21, 22 and 23 on the main terminal strip, or directly to the Input Module, whichever is easier. See the schematic to determine whether these terminals are connected to points A1, A2 and A3 on Input Module 1.

To reset all values to the Factory default:

1. Turn OFF the power,
2. Turn OFF (disconnect) Input A3 on Module 1,
3. Turn ON (jump on) Inputs A1 and A2 on Module 1,
4. Turn ON the power, wait for the RUN light to come on.
5. After the RUN light has been on for 10 seconds, turn off the power.
6. Remove the jumpers from Inputs A1 and A2, and reconnect Input A3.
7. Turn the power back on.

4 CONTROLLER NOMENCLATURE

SYMBOL	DESCRIPTION	PART NO
AAF,ABF,ACF,etc.	Binary Coded Advanced Floor Position Relays	A1
AF, BF, CF, etc.	Binary Coded Floor Position Relays	A1
BK1, BK2	Brake Contactors	B7
C	Door Close Relay (In MODSS on top of car)	A1
D / D1-2, DX	Down Run Reversing Contactor / Relays	A1
DA / DAP	Drive Activate Contactor / Pilot Relay	A1
DB1-2	Dynamic Braking Contactors	B9
DBP,DBA,DBB	Dynamic Braking Relays	A1
DC	Door Closed Relay	A1
DCC	Drive Deceleration Rate Pilot Relay	A1
DL	Down Level Relay	A1
DZ	Door Zone Relay	A1
ES, EST	Emergency Stop Switch Relays	A1,A2
ESB	Emergency Stop Switch By-Pass Relay	A1
FL, FLR	Field Loss Contactor, Relay	A2
FS, FSX	Fast Speed Run Contactor or Relays	A2
FSR	Fast Speed Run Latched Relay	A1
HD1-2	Down Hall Lantern Pilot Relays	A1
HU1-2	Up Hall Lantern Pilot Relays	A1
IAS	Inspection Access Relay	A1
LC	Leveling Cutout Relay	A1
LL	Low Leveling Speed Relay	A1
LV	Leveling Relay	A1
MG, MG1-2	Motor Generator Contactor, Relays	A1
N	Door Close Nudging Relay	A1
O	Door Open Relay (In MODSS on top of the car)	A1
P, PX	Potential Contactor, Relay	A1
RUX / RUXP	M.G. Set Running Contactor / Timer	A1,A12
SAF1-2	Safety Circuit Relays	B7
STR / RU	Motor Generator Reversing Contactors	B1
SU	Suicide Contactor	B8
TRU	Wye-Delta Run Relay (Wye-Delta Start Only)	A1
TRUP	Wye-Delta Run Timer (Wye-Delta Start Only)	D1
U / U1-2, UX	Up Run Reversing Contactor / Relays	A1
UD	Car Running Relay	A1
UDT, UDTX	Car Running Delay Drop Out Relays	A2
UL	Up Level Relay	A1
VR	Voltage Relay (Optional)	A1

PARTS SUBJECT TO CHANGE WITHOUT NOTICE.

The symbol "SAF1-2", for example, indicates that two relays (SAF1 and SAF2) have their coils connected in parallel. The part numbers shown above correspond to the part numbers shown in the next section. If no part number is shown, see the schematic.

5 PARTS LIST

ITEM DESCRIPTION

MANUFACTURER

PART NO

RELAYS AND TIMERS

A1	3PDT, 120VAC, PLUG-IN RELAY	P & B	KUP-14A35-120
A2	3PDT, 110VDC, PLUG-IN RELAY	P & B	KUP-14D35-110
A3	3PDT, 120VAC, SILVER CONTACTS	P & B	KUP-14A31F-120
A4	3PDT, 24VDC, PLUG-IN RELAY	P & B	KUP-14D35-24
A5	SURFACE MOUNT SOCKET FOR ITEM A1-4	P & B	27E893
A6	PANEL MOUNT SOCKETS FOR ITEMS A1-4	C.C.C.	CM11LSLD
A7	4PDT, 120VAC, PLUG-IN RELAY	P & B	KHAU17A12FN-120
A8	4PDT, 120VDC, PLUG-IN RELAY	P & B	KHAU17D12N-110
A9	SURFACE MOUNT SOCKET FOR ITEM A7-8	C.C.C.	MT-14-PC
A10	FIELD LOSS CONTACTOR	WARD-LEONARD	146-500 or 146-1500
A11	PHASE MONITOR	VA CONTROLS	PH MON
A12	TIMER MODULE, 0-102.3 SECONDS	ICMC	TMMS T1131

CONTACTORS AND OVERLOADS (SEE SCHEMATIC FOR CONTACTOR SIZES)

B1	REVERSING CONTACTOR, SIZE ____	FURNAS	43__P32AAE
B2	STARTER, SIZE ____	FURNAS	15__F32AF
B3	STARTER (with SCR DRIVE) SIZE ____	FURNAS/GE	SEE SCHEMATIC
B4	MOTOR OVERLOAD	FURNAS	48__C31AA4
B5	LOOP OVERLOAD	FURNAS	48__B11AA4
B6	2 POLE N.O., 120VAC COIL	FURNAS	41NB20AFP
B7	3 POLE N.O., 120VAC COIL	FURNAS	41NB30AFP
B8	3 POLE 2=N.O. 1=N.C. 120VAC COIL	FURNAS	41NB21AFP
B8	3 POLE 2=N.O. 1=N.C. 120VAC COIL	FURNAS	41NB21AF36P
B9	DYNAMIC BRAKING CONTACTOR	SIEMENS	14-193-752-587

TRANSFORMERS, FUSES AND TERMINALS

C1	460-230-208/230-115V, 600VA	MICRON	CNX600MBT1318-HD
C2	460/230V, 3KVA	JEFFERSON	211-101
C3	250V INSTANTANEOUS FUSE	LITTELFUSE	Type BLF
C4	250V FUSEHOLDER FOR ABOVE FUSE	CURTIS	PW1F
C5	TRACK FOR 250V FUSEHOLDERS	CURTIS	SW192
C6	600V TIME DELAY FUSE	GOULD	Type FRN
C7	600V FUSEHOLDER FOR ABOVE FUSE	TAYLOR	60300,60301
C8	3 POLE TERMINAL, 600V, 50AMP	CURTIS	3PSWT
C9	MOUNTING TRACK FOR TERMINALS	CURTIS	SW192
C10	15VDC POWER SUPPLY	POWER ONE	HAD-15-0.4-A

CAPACITORS AND RECTIFIERS

D1	PANEL MOUNT CAP. 20/20/40uf 250VDC	MALLORY	FP321
D2	PANEL MOUNT CAPACITOR 100uf 250VDC	MALLORY	FP321
D3	MOUNTING BRACKETS FOR D1,D2	C.D.E.	19884
D4	AXIAL LEAD CAPACITOR, 8uf, 150VDC	C.D.E.	WBR 8-150
D5	AXIAL LEAD CAPACITOR, 20uf, 150VDC	C.D.E.	WBR 20-150

ITEM	DESCRIPTION	MANUFACTURER	PART NO
D6	AXIAL LEAD CAPACITOR, 40uf, 150VDC	C.D.E.	WBR 40-150
D7	AXIAL LEAD CAPACITOR, 100uf, 150VDC	C.D.E.	WBR 100-150
D8	AXIAL LEAD CAPACITOR, 200uf, 150VDC	C.D.E.	WBR 200-150
D9	130uf, 330VAC CAPACITOR	AEROVOX	PSU12430A
D10	320uf, 450VAC CAPACITOR	MALLORY	HC45003
D11	1 PHASE IDLER DIODE	COUGAR	SA-5880
D12	3 PHASE FULL WAVE BRIDGE	COUGAR	SKD-25/12
D13	1 PHASE FULL WAVE BRIDGE	COUGAR	SKB-25/12
D14	1 PHASE F.W.B. HIGH CURRENT	COUGAR	SA3826A
D15	1 PHASE F.W.B. LOW CURRENT	COUGAR	S912
D16	BLOCKING DIODE, RELAY PANEL	COUGAR	S520

RESISTORS - PART NUMBER IS RESISTANCE AND WATTAGE - SEE THE SCHEMATIC

E1	POWER PANEL RESISTOR VALUES	RESISTORS, INC.	
	375 WATT = 4, 8, 10, 25 OHMS		
	200 WATT = 50, 100, 250, 500, 1000, 1500, 2500 OHMS		
E2	RELAY PANEL RESISTOR VALUES	RESISTORS, INC.	
	25 WATT = 1.5K OHMS		
	10 WATT = 12K, 350 OHMS		
	2 WATT = 1.5K OHMS		
E3	DYNAMIC BRAKING RESISTOR ASSEMBLY	GAL	SEE SCHEMATIC

PROGRAMMABLE LOGIC CONTROLLER

F1	CPU, WITH 5 RACK	G.E.	IC693CPU311
F2	CPU, WITH 10 RACK	G.E.	IC693CPU323
F3	CPU, SEPARATE MODULE	G.E.	IC693CPU331
F4	MAIN RACK WITH 10 SLOTS	G.E.	IC693CHS391
F5	EXPANSION RACK WITH 10 SLOTS	G.E.	IC693CHS392
F6	EXPANSION RACK WITH 5 SLOTS	G.E.	IC693CHS398
F7	POWER SUPPLY	G.E.	IC693PWR321
F8	115VAC INPUT MODULE (16 POINT)	G.E.	IC693MDL240
F9	RELAY OUTPUT MODULE (16 POINT)	G.E.	IC693MDL940
F10	IN/OUTPUT MODULE (8IN/8OUT)	G.E.	IC693MAR590
F11	24VDC INPUT MODULE (8 POINT)	G.E.	IC693MDL634
F12	24VDC OUTPUT MODULE (8 POINT)	G.E.	IC693MDL733
F13	HAND-HELD PROGRAMMER	G.E.	IC693PRG300
F14	REPLACEMENT BATTERY	G.E.	IC693ACC301

MISCELLANEOUS

G1	1"W x 2"H DUCT	TAYLOR	91020
G2	1"W x 3"H DUCT	TAYLOR	91030
G3	1"W DUCT COVER	TAYLOR	99010
G4	1"W DUCT MOUNTING CLIPS	TAYLOR	08010
G5	WESS GENERATOR REGULATOR	WESS	GFC-II
G6	NEONS, ON RELAY PANEL	I.D.I.	1030
G7	VARISTORS (SEE SCHEMATIC FOR SIZES)	G.E.	V150LA2
G8	PUSHBUTTON, ON RELAY PANEL	ARROW-HART	80511E

ITEM	DESCRIPTION	MANUFACTURER	PART NO
G9	TOGGLE SWITCH, ON RELAY PANEL	ARROW-HART	82601
G10	10 POSITION SELECTOR SWITCH	CENTRALAB	PA1001
ENCLOSURE			
H1	CONTROLLER ENCLOSURE	PIEDMONT	(SIZE)
H2	STARTER ENCLOSURE	PIEDMONT	(SIZE)
SCR DRIVE MATERIAL			
I1	S-CURVE GENERATOR	IPC	D-280
I2	TACH LOSS SENSOR, POWER SUPPLY	SCR	127-101
I3	TACH LOSS SENSOR, MAIN BOARD	SCR	127-103
I4	SCR REGENERATIVE DRIVE	EMERSON / SWEQ	SEE SCHEMATIC

INDEX of MANUFACTURERS

ARROW-HART	ARROW-HART, INC. Hartford CT
BURNDY	BURNDY CORP. Norwalk CT
BUSS	BUSSMAN MFG. DIV. St Louis MO
C.C.C.	CUSTOM CONNECTOR CORP. Cleveland OH
C.D.E.	CORNELL-DUBILIER ELECTRONICS Newark NJ
CENTRALAB	CENTRALAB Milwaukee WI
CLADDAGH	CLADDAGH ELECTRONICS, LTD Long Island City NY
CLAROSTAT	CLAROSTAT MFG CO. INC. Dover NH
COUGAR	COUGAR ELECTRONICS CORP Brooklyn NY
CURTIS	CURTIS INDUSTRIES, INC. Milwaukee WI
DELTROL	DELTROL CORP Milwaukee WI
FURNAS	FURNAS ELECTRIC COMPANY Batavia IL
G.E.	GENERAL ELECTRIC COMPANY Charlottesville VA
GOULD	GOULD SHAWMUT CO. Marble Falls TX
ICMC	INTERNATIONAL CONTROLS AND MEASUREMENT CORP NY
IDEC	IDEC SYSTEMS and CONTROLS CORP Santa Clara CA
IDI	INDUSTRIAL DEVICES INC. Edgewater NJ
LITTELFUSE	LITTELFUSE, INC. Des Plaines IL
MALLORY	MALLORY CAPACITOR CO Indianapolis IN
OMRON	OMRON CORP of AMERICA Chicago IL
O. THOMPSON	O. THOMPSON INC Woodside NY
PIEDMONT	PIEDMONT METAL FABRICATORS Culpepper VA
P & B	POTTER & BRUMFIELD
RAM	RAM TRANSFORMER CORPORATION Chatham NJ
RESISTORS INC.	RESISTORS, INC. Chicago IL
SMITH	H. H. SMITH INC. Brooklyn NY
SSAC	SSAC INC. Liverpool NY
TAYLOR	TAYLOR ELECTRIC PRODUCTS Marble Falls TX

INDEX of MANUFACTURERS

V.C.I.

VIRGINIA CONTROLS, INC. Richmond VA

ALL PARTS ARE COMMERCIALY AVAILABLE FROM THE MANUFACTURER, OR FROM VIRGINIA CONTROLS AT (804) 225-5530 (ASK FOR THE PARTS DEPARTMENT)

PARTS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

CONSULT VIRGINIA CONTROLS, INC. FOR CURRENT PRICING INFORMATION.

NON-STANDARD MATERIAL IS IDENTIFIED ON THE SCHEMATIC.

6 FIELD DEVICES

NOTE: When sequences are described for one floor all other floors are similar. Refer to the schematic for details on specific Inputs and Outputs, and the exact controller wiring. Refer also to the PLC for Operating Instructions for the Programmable Logic Controller (PLC).

6.1 FLOOR SWITCHES / SELECTOR

If Floor Switches are used, then each Floor Switch should have a normally open contact that closes under each of the following conditions:

1. the car is at the slowdown point above the floor, OR
2. the car is at the slowdown point below the floor, OR
3. the car is at the floor (optional), OR
4. the car is between the slowdown points (optional).

Conditions (1) and (2) are required to change the floor relays and initiate slowdown. Condition (3) is required at the terminal landings, but is optional at the intermediate landings. Condition (4) is optional.

There are many acceptable methods of providing the floor switch signals, such as by having a single Floor Switch at floor level, and an adjustable length cam on the car, or by having two Floor Switches per floor, and a fixed length cam on the car. The Floor Switches may be mounted on the car if they are in separate rows. It is recommended that the method used allow for separate adjustment of the up and down slowdown distances. Recommended slowdown distance is about 6" for every 25fpm of car speed, for speeds of up to 200fpm. Minimum distance for the floor switches to be activated is 1.5" for every 25fpm of car speed.

NOTE: The terminal landing Floor Switches must be maintained while the car is within slowdown distance of the terminal landing.

The pulsing-type Car Top Selector provides Floor Change/Slowdown signals and Leveling signals, as shown on the CTS sheet in the schematic. The signals should be a normally open contact that closes as described below. Refer to the schematic to see which signals are required on a specific system.

1. UP HIGH SPEED SLOWDOWN set at the High Speed Slowdown distance below the floor
2. DOWN HIGH SPEED SLOWDOWN set at the High Speed Slowdown distance above the floor
3. UP MEDIUM SPEED SLOWDOWN set at 2 Floor Run Slowdown distance below the floor
4. DOWN MEDIUM SPEED SLOWDOWN set at 2 Floor Run Slowdown distance above the floor
5. UP SLOW SPEED SLOWDOWN set at 1 Floor Run Speed Slowdown distance below the floor
6. DOWN SLOW SPEED SLOWDOWN set at 1 Floor Run Speed Slowdown distance above the floor
7. UP AND DOWN LEVEL, AND DOOR ZONE/LOW LEVEL As described later

An extra reset target may be required at each terminal landing. See the schematic.

6.2 SLOWDOWN LIMIT SWITCHES

The Terminal Landing Slowdown Limit Switch is a normally closed contact that opens when the car is closer to the terminal landing than the minimum slowdown distance. It will prevent the car from running into the terminal landing at full speed.

NOTE 1: A Terminal Landing Slowdown is required for each fast speed used (such as One Floor Run speed, Two Floor Run speed, Contract speed, etc.)

6.3 NORMAL and FINAL LIMIT SWITCHES

The Terminal Landing Normal Limit Switch is a normally closed contact that opens when the car has travelled 1" past floor level at the terminal landing. The car should not be on the Terminal Landing Normal Limit Switch when the car is floor level at the terminal landing. The Limit Switch will prevent the car from travelling further away from the normal area of car travel, but allows the car to run back towards the normal area of car travel.

The Terminal Landing Final Limit Switch is a normally closed contact that opens when the car has gone a considerable distance beyond floor level at the terminal landing. It will prevent any further movement of the car in either direction. Consult the applicable codes for the proper setting of this switch.

6.4 PIT STOP SWITCH

The Pit Switch is a toggle switch located within easy reach of the pit floor that will prevent the car from running at all if it is in the open position. The switch must be closed for the car to run.

6.5 EMERGENCY STOP SWITCH

The Emergency Stop Switch is located in the car operating panel, and consists of a toggle switch, or maintained pushbutton, with a normally closed contact that opens when the switch is in the "Stop" position. It will prevent the car from running when it is in the "Stop" position. The Emergency Stop Switch is by-passed when the car is leveling, or when the car is running and it is on Fire Service Phase 1.

6.6 CAR DOOR CONTACT

The Car Door Contact is mounted on the car door, and is closed only when the doors are fully closed. It must be closed for the car to run, EXCEPT that it is by-passed in leveling, and on Inspection Access Operation.

6.7 HALL DOOR CONTACTS

The Hall Door Contacts are located on each Hall Door at each landing. They are closed only when the Hall Doors are fully closed. They must be closed for the car to run, EXCEPT that they are by-passed in leveling, and the appropriate Hall Door Contact is bypassed on Inspection Access Operation to allow the car to move away from that floor only with the doors open.

6.8 DOOR ZONE SWITCH

The Door Zone Switch is a normally open contact that is closed when the car is close to floor level (approximately 3" above or below the floor). It will prevent the doors from opening if it is not energized. This is the same as the Low Level Switch, if used.

6.9 DOOR OPEN LIMIT SWITCH

The Door Open Limit Switch is open when the doors are fully open, and closed at all other times. It will de-energize the door open relays in the door operator when the doors have opened fully.

6.10 DOOR CLOSE LIMIT SWITCH

The Door Close limit Switch is open when the doors are fully closed, and closed at all other times. It will de-energize the door close relays in the door operator when the doors have closed fully. Depending on the type of door operator used, the Door Close Limit may be by-passed when the car is running to keep torque on the door motor.

6.11 SAFETY EDGE

The Safety Edge provides a normally open contact that closes when the Safety Edge on the leading edge of the doors encounters an obstruction while the doors are closing. This will cause the doors to re-open. Unless otherwise specified, the Safety Edge will open the doors fully on Fire Service Phase 1 if the doors are already partially open, but it is cut out on Fire Service Phase 2.

6.12 ELECTRIC EYE

The Electric Eye provides a normally open contact that closes when the Electric Eye detects an object in the path of the doors. It will cause the doors to re-open. The Electric Eye is cut out on Fire Service.

6.13 DOOR OPEN BUTTON

The Door Open Button provides a normally open contact that closed when the Door Open Button is pressed. It will re-open the doors. Unless otherwise specified, the Door Open Button opens the doors fully on Fire Service Phase 1, if the doors are already partially open, and opens the doors with constant pressure on Fire Service Phase 2.

6.14 DOOR CLOSE BUTTON

The Door Close Button provides a normally open contact that closes when the door Close Button is pressed. It shortens the door time in preparation for responding to the call.

6.15 CAR CALL BUTTONS

The Car Call Button is a double pole, single throw momentary type pushbutton in the car station. One button is provided for each opening, and the button is usually an illuminated button. Both poles of the button close when the button is pressed. One pole registers the call and shortens the Door Time, and the second pole will close the doors on Fire Service Phase 2, if it is connected in parallel with the Door Close Button.

6.16 HALL CALL BUTTONS

The Hall Call Button is a single pole, single throw momentary pushbutton located in each hall station as required. The button is usually illuminated. The contact in the pushbutton closes when the button is pressed.

6.17 UP LEVEL SWITCH

The Up Level Switch provides a normally open contact that closes when the car is between 1/4" and 9" below floor level. The Up Level Switch initiates stopping and re-leveling in the Up direction. The distance before the floor that the Up Level Switch energizes determines the length of the Leveling Zone, and should be about 9". The car will ramp from Approach Speed to Leveling Speed at this point. When the car is floor level it should be 1/4" above the Up Level Switch. This allows the car to move slightly without re-leveling back to the floor.

6.18 DOWN LEVEL SWITCH

The Down Level Switch provides a normally open contact that closes when the car is between 1/4" and 9" above floor level. The Down Level Switch initiates stopping and re-leveling in the Down direction. The distance before the floor that the Down Level Switch energizes determines the length of the Leveling Zone, and should be about 9". The car will ramp from Approach Speed to Leveling Speed at this point. When the car is floor level it should be 1/4" below the Down Level Switch. This allows the car to move slightly without re-leveling back to the floor.

6.19 LOW LEVEL SWITCH

The Low Level Switch provides a normally open contact that closes when the car is in the Low Level Zone. The Low Level Zone is not usually required if a Door Zone Switch is provided, since it is the same as the Door Zone.

6.20 INSPECTION ACCESS SWITCH

The Inspection Access Key Switch in the car station is usually a single pole, double throw contact. In the "Off" position, it allows normal operation. When the key switch is turned to the "On" position it activates the Hoistway Access Switches.

NOTE: Applicable codes may require additional poles. Refer to the schematic for specific job requirements.

6.21 HOISTWAY ACCESS SWITCHES

The Hoistway Access Switches are located at the appropriate landing, and provide a means to move the car away from the floor with the doors open, to allow access to the top of the car, or to the pit area. The switches are double pole, double throw, with a center off position. One pole initiates the run in a similar manner to Inspection operation, and the other pole by-passes the door contacts at that floor. A Zone switch is usually used in conjunction with the top landing Hoistway Access Switch to prevent the car from being moved too far from the floor, and leaving the shaftway open. The Zone Switch is usually a normally open contact that closes when the car is in the proper zone for operation on Hoistway Access. The applicable elevator codes may require additional Zone Switches for safer operation.

6.22 TOP OF CAR INSPECTION SWITCHES

The Top of Car Inspection Station usually contains the following devices:

1. Inspection Stop Switch that provides a normally closed contact. It will stop the car if it is opened.
2. Inspection Switch that is a single pole, double throw switch which activates the Inspection Buttons and cuts out automatic operation if turned to the "Inspection" position.
3. "Up", "Down", and "Run" Buttons which are single pole normally open buttons. The "Run" Button and either the "Up" or the "Down" button must be pressed to make the car run on Inspection. The car will stop when either button is released.

6.23 HALL FIRE SWITCH

The Hall Fire Switch in the hall station is a three position switch that initiates Fire Service Phase 1. The three positions, in order, are "Bypass", "Off" and "On". The key is removable in the "Off" and "On" positions only, and the "Bypass" position is spring-return back to the "Off" position. NOTE: For normal operation, the Fire Service Phase 1 Input must be ENERGIZED.

The Hall Fire Switch will normally be left in the "Off" position. The "Off" position allows normal operation of the elevator, unless Fire Service is initiated by the Smoke Detectors. The car will return to the Alternate Fire Floor if the Main Landing Smoke Detector is tripped, if it is provided, otherwise the car will return to the Main Fire Floor. The Smoke Detectors should have a normally open contact that is closed under normal operation, and opens when a fire is detected. The Smoke Detector contact should not be self-resetting, but should be reset manually, or by removing power to the Smoke Detector, as required by applicable codes. The "Off" pole should only be closed when the switch is in the "Off" position. The "Bypass" position allows the car to remain on automatic operation even though one or more of the Smoke Detectors have tripped. The "Bypass" pole should only be closed when the switch is in the "Bypass" position. The "On" position initiates Fire Service Phase 1, and recalls the car to the main landing even if the Main Landing Smoke Detector is tripped. The "On" pole should only be closed when the switch is in the "On" position.

6.24 FIRE SWITCH - CAR

The Fire Switch in the car operating panel (Car Fire Switch) is a two or three position key switch, depending upon the applicable codes, that initiates Fire Service Phase 2. If it is a two position switch, the positions are "Off" and "On", and if it is a three position switch the positions are "Off", "Hold" and "On". The operation may vary depending upon the particular requirements of the job, or the requirements of applicable codes. The "On" position will initiate Fire Service Phase 2, if the car is at the main landing, with the doors open. Fire Service Phase 2 will be self-holding until the car has returned to the main landing and opened the doors. The "On" pole should only be closed when the switch is in the "On" position. The "Hold" position, if used, will not affect the operation unless the doors are fully open. If the doors are fully open, then the Car Call Buttons and Door Close Button will be cut out, all car calls will be cancelled, and the car will remain at the floor with the doors fully open until the Car Fire Switch is turned to "On" or "Off". This feature is only provided with a three position switch. The "Hold" pole should only be closed when the switch is in the "Hold" position.

With a two position switch, and if the doors are fully open, the "Off" position will cut out the Car Call Buttons and the Door Close Button, cancel all the calls, and hold the car with the doors open. With a three position switch,

and if the doors are fully open, the "Off" position will initiate an automatic return to the main landing, where the car will return to Fire Service Phase 1. The "Off" pole should only be closed when the switch is in the "Off" position. A Fire Call Cancel Button, if provided, will cancel all Car Calls when pressed.

6.25 INDEPENDENT SERVICE SWITCH

The Independent Service Switch is a normally open key switch located in the car operating panel that closes when it is turned to the "On" position. It initiates the Independent Service feature.

6.26 POSITION INDICATOR LIGHTS

The Position Indicators are lights that indicate the position of the car in the shaftway. They will change to the next floor when the car reaches the slowdown point for the new floor. Position Indicators in the hall and in the car should be connected in parallel, and they are 115VAC.

6.27 DIRECTION INDICATOR LIGHTS

The Direction Indicator Lights indicate the direction that the car is set to run, based on the existing calls. If the car has no preset direction, these lights will not be lit. The Direction Indicator Lights will go out when the car slows down for the last call, if it is a car call, or when the doors start to close, if it is a hall call. A hall call will select a direction, and therefore light the Direction Indicator Lights, even if the car was at the same landing as the call. These are not the same as Direction Lanterns. The Direction Indicator Lights are 115VAC.

6.28 DIRECTION LANTERNS

The Direction Lanterns are located either in the door jamb of the car (Traveling Lanterns), or in the hall stations at each landing (Hall Lanterns). They will indicate the car is stopping for a call, and also the direction that the car is set to run next. This is similar to the Direction Indicator Lights, except that they only come on when the car is stopping for a call. The Hall Lanterns for a particular landing are lit when the car initiates slowdown at that landing, and are extinguished when the doors close. The Traveling Lanterns are lit when the doors have started to open after the car has stopped for a call, and are extinguished when the doors close. If specified, circuitry may be provided to sound the Down Direction Lantern twice, providing two strokes on the associated gong, to indicate the difference between an Up traveling car and a Down traveling car. The Direction Lanterns are 115VAC.

6.29 LIGHT UP BUTTONS

Light Up Buttons are usually provided for Car and Hall Calls. They indicate that a call has been registered, and are extinguished when the call is answered. The Light Up Buttons are 115VAC.

6.30 PASSING GONG

The Passing Gong is mounted in the car, usually as part of the Car Position indicator, and it sounds each time the car passes a floor. This enables passengers to determine the location of the car by counting the pulses on the Passing Gong. The Passing Gong is 115VAC.

6.31 FIRE SERVICE LIGHT

The Fire Service Light is located in the car and hall stations, and is lit when the car is on Fire Service Phase 1 or 2. The Fire Service Light is 115VAC.

6.32 FIRE AUDIBLE, VISIBLE SIGNAL

The Fire Service Audible Visible Signal is located in the car station, and is energized when the car is on Fire Service Phase 1, and the car is returning to the main landing, or it is on Inspection operation. The signal indicates that Fire Service is initiated, and that the car should be allowed to return to the main landing, if it is being held for any reason. The Fire Service Audible Visible Signal is 115VAC.